WASHINGTON STATE BOARD OF HEALTH

Notice of Public Meeting

Tuesday, October 8, 2024, 9:30 a.m. – 3:40 p.m.
Physical meeting location:
Hilton Garden Inn Yakima
Cascade Ballroom
401 E. Yakima Avenue
Yakima, WA 98901
Virtual meeting: ZOOM Webinar
(hyperlink provided below)
Language interpretation available

Final Agenda

Time	Agenda Item	Speaker
9:30 a.m.	Call to Order & Introductions	Patty Hayes, Board Chair
9:40 a.m.	1. Approval of Agenda – Possible Action	Patty Hayes, Board Chair
9:45 a.m.	2. Approval of August 7, 2024, Minutes – Possible Action	Patty Hayes, Board Chair
9:50 a.m.	3. Public Comments	Please note: Verbal public comment may be limited so that the Board can consider all agenda items. The Chair may limit each speaker's time based on the number people signed up to comment.
10:20 a.m.	4. Cheney Water Recreation Variance Request, Chapters 246-260 & 262 WAC – Possible Action Yakima Water Recreation Variance Request, Chapters 246-260 & 262 WAC – Possible Action	Patty Hayes, Board Chair Shay Bauman, Board Staff Dave DeLong, Department Staff
11:35 a.m.	Break	
11:50 a.m.	5. Yakima Public Health	Andre Fresco, Executive Director, Yakima Health District Ashley Bell, Board Staff
12:20 p.m.	Lunch	

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Time	Agenda Item	Speaker
1:10 p.m.	6. Rules Briefing – Group A Public Water Supplies, WAC 246-290-315(8) PFAS Emergency Rulemaking – Possible Action	Kate Dean, Board Member Shay Bauman, Board Staff
1:30 p.m.	7. Introduction – Sense of the Board	Patty Hayes, Board Chair Michelle Davis, Board Executive Director
1:40 p.m.	8. Update—School Rule Review Project	Patty Hayes, Board Chair Andrew Kamali, Board Staff
1:55 p.m.	9. Update— Newborn Screening Project	Kelly Oshiro, Board Vice Chair Kelly Kramer, Board Staff Molly Dinardo, Board Staff
2:10 p.m.	10. Rules Update – Sanitary Control of Shellfish, Chapter 246-282 WAC	Patty Hayes, Board Member Shay Bauman, Board Staff
2:30 p.m.	Break	
2:40 p.m.	11. Announcements and Board Business	Michelle Davis, Board Executive Director
3:00 p.m.	12. Department of Health Update and Be Well WA	Dr. Tao Kwan-Gett, Department of Health
3:20 p.m.	13. Board Member Comments and Updates	
3:40 p.m.	Adjournment	

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- **To access the meeting online and to register:**
  https://us02web.zoom.us/webinar/register/WN_IIZ8bH2ESsWvk_dhGuyDTQ

- **You can also dial-in using your phone for listen-only mode:**
  Call in: +1 (253) 215-8782 (not toll-free)
  Webinar ID: 841 9960 3546
  Passcode: 682856

Important Meeting Information to Know:

- Times are estimates only. We reserve the right to alter the order of the agenda.
- Every effort will be made to provide Spanish interpretation, American Sign Language (ASL), and/or Communication Access Real-time Transcription (CART) services. Should you need confirmation of these services, please email wsboh@sboh.wa.gov in advance of the meeting date.
- If you would like meeting materials in an alternate format or a different language, or if you are a person living with a disability and need reasonable modification, please contact the State Board of Health at (360) 236-4110 or by email wsboh@sboh.wa.gov. Please make your request as soon as possible to help us meet your needs. Some requests may take longer than two weeks to fulfill. TTY users can dial 711.

Information About Giving Verbal Public Comment at Hybrid Meetings:

- Individuals may give verbal public comments at the meeting, in-person or virtually, during the public comment period.
- The amount of time allotted to each person will depend on the number of speakers present (typically 1 to 3 minutes per person). We will first call on those who have signed up in advance.
- Sign up **by 12:00 Noon the day before a meeting** to participate in the public comment period:
  - Email the Board or
  - Register through the **Zoom webinar link. The Zoom webinar link is in the meeting agenda located on the** Meeting Information webpage**.**
  - If you are **attending the meeting in person** and did not sign up in advance, you may write your name on the sign-in sheet to provide comments if time allows.

Information About Giving Written Public Comment:

- Please submit your written comments by **12:00 Noon on Thursday, October 3.**
- Please visit the Board's Public Comment webpage for details.

Draft Minutes of the State Board of Health
August 7, 2024
Hybrid Meeting
ASL (or CART) and Spanish interpretation available
Pacific Tower
Panoramic Center
1200 12th Avenue South, Suite 810
Seattle, WA 98144
Virtual meeting: ZOOM Webinar

State Board of Health Members present:
Kelly Oshiro, JD, Vice Chair
Stephen Kutz, BSN, MPH
Kate Dean, MPA
Socia Love, MD
Umair A. Shah, MD, MPH
Tao Sheng Kwan-Gett, MD, MPH, Secretary's Designee
Paj Nandi, MPH
Dimyana Abdelmalek, MD, MPH
Michael Ellsworth, JD, MPA, Secretary's Designee

State Board of Health Members absent:
Patty Hayes, RN, MSN, Chair
Mindy Flores, MHCM

State Board of Health staff present:
Michelle Davis, Executive Director
Melanie Hisaw, Executive Assistant
Michelle Larson, Communications Manager
Anna Burns, Communications Consultant
Heather Carawan, Communications Consultant
Molly Dinardo, Health Policy Advisor
Shay Bauman, Health Policy Advisor
Jo-Ann Huynh, Administrative Assistant
Lilia Lopez, Assistant Attorney General
Hannah Haag, Community Engagement Coordinator
Ashley Bell, Equity & Engagement Manager
Cait Lang-Perez, Health Policy Analyst
Lindsay Herendeen, Health Policy Analyst
Miranda Calmjoy, Health Policy Analyst
LinhPhụng Huỳnh, Health Disparities Council Manager
Esmael López, Health Disparities Council Lead Community and Tribal Engagement Coordinator
Gavin Rienne, Health Disparities Council Social Epidemiologist
Andrew Kamali, School Rules Project Manager
Nina Helpling, School Rules Project Policy Advisor
Mary Baechler, School Rules Project Community Engagement Coordinator
Marcus DeHart, School Rules Project Communications Consultant
Kelly Kramer, Newborn Screening Project Policy Advisor

Guests and other participants:
Brad Finegood, Seattle & King County Public Health
Dave DeLong, Department of Health
Jeremy Simmons, Department of Health
John Thompson, Department of Health

Kelly Oshiro, Board Vice Chair, called the public meeting to order at 9:30 a.m. and read from a prepared statement (on file). Michelle Davis, Board Executive Director, introduced the public comment process, Board Members gave introductions, and Executive Director Davis gave the land acknowledgment.

1. **APPROVAL OF AGENDA**
   Motion: Approve August 7, 2024 agenda
   Motion/Second: Member Kutz/Member Nandi. Approved unanimously

2. **ADOPTION OF June 12, 2024 MEETING MINUTES**
   Motion: Approve the June 12, 2024 minutes
   Motion/Second: Member Kutz/Member Nandi. Approved unanimously

3. **PUBLIC COMMENT**
   Kelly Oshiro, Board Vice Chair, opened the meeting for public comment and read from a prepared statement (on file).

   Gerald Braude, Jefferson County, explained that their comments at the June 2024 Board meeting referenced deaths from COVID-19 shots, not just reports to the Vaccine Adverse Event Reporting System (VAERS). G. Braude said that Washington state now has up to 235 reported deaths and over 23,870 reports to VAERS after the COVID-19 vaccines. These reports include seizures, cardiac arrests, Bell's palsy, Guillain-Barré syndrome, and severe allergic reactions.

   Mariah Kunz, Arcora Foundation, highlighted the importance of community water fluoridation in improving oral health and preventing tooth decay, as endorsed by the Centers for Disease Control (CDC). M. Kunz acknowledged the challenges posed by misinformation on the internet and thanked the Board for ongoing recognition of its benefits.

   Lisa Templeton, Informed Choice Washington (ICW), said their comments were submitted on time for the packet but not present. L. Templeton commented on the bird flu, and the non-controversial prevention strategies shown to be safe and effective to prevent disease and transmission.

   Sara McCarthy, commented in support of adding Wilson's Disease to the Newborn Screening (NBS) panel. S. McCarthy found out their baby had Wilson's Disease due to genetic testing from known risks. Their child takes meds two times a day, is monitored annually and since they have known about it since day one, they can stay ahead of symptoms and avoid pain and stress.

Bill Osmunson, said they once promoted water fluoridation, but now have opposed it for years. B. Osmunson said the Board of Pharmacy considers fluoride a prescription drug and said the Board of Health has been silent on their request for a forum.

Janet Laubgross, commented in support of adding Wilson's Disease to the Newborn Screening (NBS) panel. J. Laubgross talked about their son who was diagnosed on his 24 birthday. Now he is 26 and is fully chelated and in good health. Unfortunately, he suffered for years as a teenager with elevated liver enzymes, and psychological and behavioral issues. NBS testing would have saved years of heartache. Their son will have cirrhosis of his liver for the rest of his life. J. Laubgross advocated for testing of children at birth to avoid heartache and the permanent damage caused by Wilson's Disease.

4. **ANNOUNCEMENTS AND BOARD BUSINESS** – switched with Agenda Item 10, at 1:30pm.

Michelle Davis, Board Executive Director, welcomed the Board to Seattle. Executive Director Davis said that Chair Hayes and Member Flores couldn't join today's meeting, and Member Abdelmalek and Member Dean are attending virtually.

Executive Director Davis announced Ashley Bell has received a certification as a Certified Diversity Professional from the Institute for Diversity Certification. Executive Director Davis then directed Board Members to review the new staff biographies for the School Rule project and Newborn Screening project under agenda item 4 (materials on file). Executive Director Davis acknowledged the new staff members present at the meeting.

Executive Director Davis provided an overview of recent rule filings. This included the per- and polyfluoroalkyl (PFAS) emergency rule CR-103E (WAC 246-290-315) and an action to delay the effective date of the school rule CR-103 (chapter 246-366A). Additionally, a CR-101 was initiated to draft a proposed new rule for school environmental health and safety (chapter 246-370 WAC). Finally, a CR-103 was adopted to implement changes to the Board's Handling of Human Remains rule (chapter 246-500).

Executive Director Davis shared correspondence related to recent rule petitions. One correspondence addressed the denial of a petition for rulemaking from David Belanger related to the Board's water recreation rules. The other correspondence was the Governor's response to Bill Osmunson, denying the appeal of the Board's decision to reject the petition to amend WAC 246-390-220 related to fluoride and Group A Water systems.

Executive Director Davis indicated that staff would ask Chair Hayes to call a special meeting later in August to decide on variance requests for Water Recreation Facilities. Executive Director Davis encouraged Board Members to attend the local board of health orientation training sponsored by the Washington State Association of Counties. Executive Director Davis also noted that the Health Disparities Council (HDC) would present on the Council's redesign, which centers on health justice, and a proposal to create a statewide vision for health and wellbeing at the Washington State Public Health Association conference also scheduled for October.

5. SEATTLE & KING COUNTY LOCAL HEALTH UPDATE: PUBLIC HEALTH APPROACH TO OVERDOSE PREVENTION

Ashley Bell, Board staff, introduced Brad Finegood, Strategic Advisor for Overdose Prevention with Public Health—Seattle & King County (PHSKC).

Brad Finegood, PHSKC, provided an overview of PHSKC's Overdose Prevention Strategic Plan. Brad stated the mission of the plan is to prevent overdose, save lives, and improve the quality of life for all people in King County. Brad shared information about PHSKC's overdose prevention programs, including training, community support, and harm reduction programs. Brad talked about current work in progress, including opening Crisis Care Centers and a Post-Overdose Recovery Center (presentation on file).

Umair A. Shah, Secretary of Health, stated the importance of continuing this work to ensure the positive trend continues. Secretary Shah stated that there are racial/ethnic inequities, and we need to highlight those inequities, while also emphasizing that overdose can impact any Washingtonian at any moment. Secretary Shah asked Brad to reflect on opportunities to work with communities most devasted by this. Secretary Shah also stated that the data from King County reflects work across Washington State and mentioned the Department of Health (Department) data dashboard. Secretary Shah stated that the state is connected and vested in supporting local health. Secretary Shah asked if Brad could also talk more about strategies and work with communities most impacted.

Brad stated that coordination with the state is essential to the work. Brad said that, as a white male, they have learned so much by working with Native community partners and what a Tribal approach to healing looks like. Brad talked about work with the Muckleshoot and Cowlitz Tribe. Brad stated that the journey toward anti-racism and understanding their own personal positionality in this work has been valuable. Brad also discussed working with Urban Indians and the suffering they experience and the correlation with people who are unsheltered and using substances as a coping mechanism. Brad stated that communities view substance use in many ways so the response to substance use needs to differ. Brad also discussed the importance of working alongside the community.

Secretary Shah stated this work also connects to the Department's pillars.

Paj Nandi, Board Member, stated they are working with Little Saigon and, living in this area, understands the impacts of overdose on communities in King County. Member Nandi said that King County has a comprehensive approach to this work and is a leader in this work. Member Nandi asked to connect with Brad offline to discuss the work the Health Care Authority (HCA) is doing in this area, especially around youth and young adults. Member Nandi talked about two different HCA initiatives related to this work. Member Nandi stated this is an intersectional issue. Member Nandi also stated that Native Community leaders and Tribal leaders are vital to leading this work.

Brad stated that harm reduction often gets a bad reputation, but it is important to save lives and ensure access to care and services. Brad said that services need to be in a continuum and upstream as well. Brad stated that youth and young adults are suffering in mental health. The group suffering the highest rate of overdose by demographics and age are older community members and people aged 65 years and older are the fastest growing group impacted by drug overdose. Older adults experience co-morbidities and are impacted by aging and losing their house due to affordability.

Kelly Oshiro, Board Vice Chair, acknowledged that Members Dean and Kutz also had questions and encouraged connection between Brad and Board Members following today's meeting.

Michelle Davis, Board Executive Director, stated that there is additional information on PHSKC's website and that Brad has also provided Ted Talks on the topic and encouraged Board Members to learn more.

6. YAKIMA WATER RECREATION VARIANCE REQUEST, CHAPTERS 246-260 & 262 WAC

Kate Dean, Board Member, provided an overview of the Board's authority related to water recreation facilities. The Board has the authority to grant a variance to WAC 246-262-010(21) related to "diving envelopes", which is the section of law related to the variance requests.

Andrew Kamali, Board staff, stated that the Board has received two water recreation variance requests, including variances related to a water recreation facility in Yakima County and in Cheney. Andrew introduced Dave DeLong, Water Recreation Lead for the Washington State Department of Health.

Dave DeLong, Department staff, provided an introduction to the three equipment requests associated with the Aquatic Center at MLK Jr Park in Yakima County (Aqua Climbing Wall, Aqua Zip-N, Ninja Cross Obstacle Course). Dave provided an overview of the section of law related to "diving envelopes" to protect the safety of people diving into a body of water. Dave shared information about the three features being proposed at MLK Jr Park, including the proposed features and applicable safety standards. Dave stated that the Department and Board staff are still reviewing the data, arguments, and mitigations proposed by the facility and are not prepared to give an evaluation or recommendation to the Board at this time (presentation on file).

Andrew stated that this information is to prepare the Board for additional discussion at a later date and staff will ask Board Members to consider convening a special meeting of the Board to take action on the variances.

Steve Kutz, Board Member, stated that, when looking at various features, you are hanging, not jumping off. Member Kutz asked whether the standards are related to the height where the tips of their feet are hanging or where their hands are. Member Kutz also asked about how the standards consider different heights and weights of people. For example, someone who weighs more and may go deeper in the water than someone who weighs less. Member Kutz stated that they will want a better understanding of these issues when the Board goes more in-depth later.

Dave acknowledged this is very complex and Department staff have some of the same questions and are going through information provided by the engineering team. They are considering where people will hang and forces when hitting the water. Dave stated they could provide more information and staff analysis at a later date.

Tao Kwan-Gett, Chief Science Officer, Secretary's Designee, stated that, as a pediatrician and parent, teens and young adults are at a developmental state where high-risk behavior is a norm. Member Kwan-Gett stated that we need to consider and engineer these places to ensure the safety of the person who does the high-risk thing, not just how most kids or adults may use these features.

Dave stated that creative play is something to consider.

Kelly Oshiro, Board Vice Chair, stated that staff have recommended a special meeting and will send a Doodle Poll to Board Members by the end of the week. Vice Chair Oshiro stated that staff has proposed a 1.5 hour-long meeting to review both the Yakima and Cheney variance requests.

Andrew stated staff are recommending August 28, 2024, for a special meeting.

Vice Chair Oshiro stated staff will send a Doodle Poll for August 28 to ensure Board Members can attend and can ensure a quorum. Vice Chair Oshiro asked staff to reach out to petitioners to share the date of the meeting as soon as it is determined.

Member Kutz also asked if legal counsel could provide a briefing on legal risk to the Board if decisions pose a risk to the public.

Lilia Lopez, Assistant Attorney General, stated that the Board's consideration is related to health and safety.

Vice Chair Oshiro asked if staff could also discuss historical Board decisions about granting variances like the features being proposed in these two variances.

7. CHENEY WATER RECREATION VARIANCE REQUEST, CHAPTERS 246-260 & 262 WAC

Kate Dean, Board Member, introduced the topic and asked staff from the Board and Department of Health (Department) to present. Member Dean said this request is like the last topic but will require an independent analysis from the Board.

Dave DeLong, Department of Health, said this variance request concerns the same three types of equipment as the previous topic (Aqua Climbing Wall, Aqua Zip-N, Ninja Cross Obstacle Course). Dave added that the only difference is how they are being located because this request is for a different pool, which is in Cheney. Dave said that the Aqua Climbing Wall and the Aqua Zip-N exist in other places in the state, but the Ninja Cross Obstacle Course is new and has yet to be installed in the state.

Dave presented information on the variance request, diving envelopes, the Cheney Climbing Wall, Cheney Aqua Zip-N, and the Ninja Cross (presentation on file). Dave said the Spokane Regional Health District (SRHD) is currently reviewing pool construction. Additionally, the Department is working closely with SRHD on the variances as well as recommendations to bring to the Board at a future Board meeting.

Stephen Kutz, Board Member, asked whether there are recommendations from manufacturers on the safety features and installation of these devices. Dave confirmed and said that those manufacturer and vendor recommendations are part of the variance materials submitted. Dave added that the vendor has recommended a depth of four feet for the Ninja Cross.

Andrew Kamali, Board staff, asked whether there are mitigation tactics that could void the need for a variance approval from the Board. Dave responded that it may be possible. Dave added that there is discussion about whether the Ninja Cross may already be compliant since dive standards are for things entering from above the water, whereas the use of the Ninja Cross could mean that part of the body is virtually always in the body when the device is being used properly.

Dimyana Abdelmalek, Board Member, asked about the level of supervision that may be available or needed for these devices. Member Abdelmalek asked about the potential risks of using the Ninja Cross, assurances that people are not entering the water from an extended height, and the Board's role and scope related to the safe use of devices. Dave agreed with Member Abdelmalek's comments and concerns. Dave added that Department staff are speaking with facility owners about the need to have well-written operations plans for all devices.

Kelly Oshiro, Board Vice Chair, commented on the distance between bars on the devices and people potentially jumping between the bars. Vice Chair Oshiro said the water may be too shallow for people wanting to jump into the water. Vice Chair Oshiro said the Board can continue discussing the Yakima and Cheney variance requests at a future Board meeting, which will be scheduled at a later time.

Member Dean requested that staff provide multiple date options for this future meeting.

8. RULEMAKING PETITION – WAC 246-272A-0240, HOLDING TANK SEWAGE SYSTEMS – ON-SITE SEWAGE – POSSIBLE ACTION

Kate Dean, Board Member, said the Board will discuss the petition for rulemaking on WAC 246-272A-0240 that came from a person in Jefferson County. Member Dean invited staff from the Board and Department of Health (Department) to present. Member Dean said that after the briefing and discussion, the Board may choose to make a motion.

Shay Bauman, Board staff, provided an overview of the petition for rulemaking. This included a background of holding tank systems, the current rule, the authority of local health officers to grant waivers to this chapter of rule, the minimum criteria for granting a waiver, and the staff's recommendation to decline the petition for rulemaking (presentation on file).

Steve Kutz, Board Member, said there are local considerations that make it important for local public health to be involved (e.g., being next to a stream, lake, or saltwater body), and sometimes a statewide rule makes it hard to account for these independent local variables.

Member Dean asked Board staff to speak about the input staff have received from environmental health directors. Shay responded that staff have reached out to directors in Jefferson and Mason Counties. Shay said that Jefferson County is working with the petitioner to find solutions. Shay added that, due to the risks involved, Jefferson County allows this type of waiver less often whereas Mason County has different capabilities and is looking into using these waivers more often. Member Dean said communities that are waterfront and are adjacent to Mason County, where waivers are more used, may perceive inequities.

Motion: The Board declines the petition for rulemaking to amend WAC 246-272A-0240 for the reasons articulated by Board Members. The Board directs staff to notify the petitioner of the Board's decision.
Motion/Second: Member Kutz/Member Kwan-Gett. Approved unanimously**.**

The Board took a break for lunch at 12:05 p.m. and reconvened at 1:00 p.m.

9. HEALTH IMPACT REVIEWS – FISCAL YEAR 2024 UPDATE

Cait Lang-Perez, Miranda Calmjoy, and Lindsay Herendeen, Board staff, provided their annual update on Health Impact Reviews (HIRs). The team shared an overview of HIRs and provided a recap of HIR work during the 2024 Fiscal Year. They also shared updates about longer-term projects, including an update about compensating key informants who participate in the HIR process and revising the HIR Strength-of-Evidence methods. The team also invited Board Members to offer support in reviewing the Strength-of-Evidence methods (presentation on file).

Steve Kutz, Board Member, praised the extensive work on HIRs and inquired whether staff have revisited or re-reviewed previous HIRs or used past findings for new reviews.

Miranda responded that the HIR team often receives requests for updated reviews of bills previously assessed, particularly if a bill is not fully enacted, requires updates, or if amendments are introduced. In these cases, the team uses the original HIR as a starting point and incorporates any new literature or data. Miranda added that additional key informants might be consulted depending on the topic and the timing of the original review.

Member Kutz followed up with a comment about weighing key informant interviews as evidence in the reviews and offered to support the team as they reviewed the strength-of-evidence methods.

Dr. Tao-Kwan-Gett, Secretary's Designee, congratulated the HIR team's efforts and inquired about the criteria for assessing the strength of evidence. Member Kwan-Gett asked whether the criteria assess individual sources or the overall body of evidence on the research for a specific topic.

Lindsay thanked Member Kwan-Gett for the question and explained that the strength-of-evidence criteria involves multiple layers of detail. Each piece of evidence is rated individually, considering aspects like study design, execution, and generalizability. For the overall strength of evidence for each step of the logic model in an HIR, the entire body of evidence is evaluated, which may include various sources such as published research, reports, data, and information from key informants. Lindsay added that the HIR methodology takes each of the specific ratings for each piece of evidence, and then combines them into a full strength-of-evidence rating for each step in the pathway.

Member Kwan-Gett thanked the team and offered to support their work.

Kelly Oshiro, Board Vice Chair, praised staff and noted that one of the most striking aspects of the HIR team's presentation was the slide detailing the number of reviews completed during the 2024 legislative session, particularly given its briefness this past year.

Member Kutz inquired whether the HIR team tracks or monitors website traffic for HIRs to determine who reads or uses these reviews in their work.

Lindsay said that this was a great question, and their team would need to seek guidance from the Board's communications team to track this information. Their team hasn't explored this as an option before.

Socia Love, Board Member, thanked the team and expressed interest in hearing about how the HIR team will continue to assess their process and ensure accountability.

10. **RULEMAKING PETITION – CHAPTER 246-650 WAC, NEWBORN SCREENING, REQUEST TO ADD WILSON'S DISEASE**—switched with Agenda Item 4, presented in the morning portion.

Kelly Oshiro, Board Vice Chair, introduced this agenda item by summarizing the Board's petition for the rulemaking process and the statutory requirements it must follow. Vice Chair Oshiro also reminded the Board of its authority regarding newborn screening rulemaking and provided a brief overview of the petition requesting the addition of Wilson's Disease to the Washington State newborn screening panel.

Kelly Kramer, Board staff, provided an overview of the Board's process for considering candidate conditions for newborn screening. Kelly then provided background on the petition and the condition, including a high-level overview of Wilson's Disease, available screening technologies, diagnostic testing and treatment options, the potential for prevention, and the medical rationale for universal screening (presentation on file).

John Thompson, Newborn Screening Director, Department of Health, outlined considerations for the Wilson's Disease petition for rulemaking. No other states are currently screening for this condition, and it is not on the federal Recommended Uniform Screening Panel (RUSP). John also shared that the Department of Health (Department) is running a pilot project for Wilson's Disease screening and has worked with the petitioner, Dr. Sihoun Hahn from Key Proteo, for over fifteen years to develop screening tests for the condition.

Steve Kutz, Board Member, inquired about the status of the ongoing Wilson's Disease pilot program and the expansion of screening testing. Member Kutz asked whether the testing system has been accelerated to match the increased volume of testing that would be required if the Board decides to add the condition.

John responded that the Department's Newborn Screening program provides anonymous specimens to Key Proteo, which performs the testing in its labs. John added that the Department is unaware of the latest study findings, as its primary role is to provide anonymous specimens for testing and to advise on what makes a good screening test for universal newborn screening programs. John suggested that the petitioner might best address this question.

Socia Love, Board Member, reflected that many physicians learn about Wilson's Disease in their medical training, but due to its rarity, it isn't encountered often in practice. Member Love then inquired about the average age of diagnosis for Wilson's Disease and noted that the Board may need additional information on the screening test, particularly its cost-effectiveness and feasibility, as the pilot screening process is still in its early stages. Member Love concluded by emphasizing the importance of considering any proprietary aspects of the request and evaluating the possible addition of the condition from both a cost and equity perspective.

Kelly responded that from available research, the average age of diagnosis for Wilson's Disease is around age forty or so.

Dimyana Abdelmalek, Board Member, echoed Member Love's comments and stated that, as Board Members heard in public comments, undiagnosed Wilson's Disease significantly impacts people's lives. Member Abdelmalek said it would be interesting to learn more about the test and its costs and hear more about the impacts of early detection subject matter experts who treat people with this condition and their families.

Kate Dean, Board Member, stated that based on the presentation and the petitioner's materials, Wilson's Disease appears to preliminarily meet the Board's criteria, except for the cost-benefit analysis of screening for the condition. Member Dean suggested that it may be worthwhile to consider forming a technical advisory committee to evaluate this condition further.

Dr. Umair A. Shah, Secretary of Health, thanked the presenters and acknowledged the petitioner's efforts. Secretary Shah inquired about the prevalence of Wilson's Disease, noting a discrepancy between the presentation's figure of 1 in 30,000 and new UK data suggesting 1 in 7,000. Secretary Shah emphasized that this discrepancy highlights the need for a technical advisory committee to dive deeper into the data. Secretary Shah also shared that as a practicing physician, they cared for a person with Wilson's Disease. It's a very difficult diagnosis, and we do not currently have a prevention method.

Member Kutz agreed with Board Members and said that establishing a technical advisory committee is the best way for the Board to determine whether Wilson's Disease meets its five newborn screening criteria.

Motion: The Board declines the petition for rulemaking to add Wilson's Disease as a condition for newborn screening in Chapter 246-650 WAC and directs staff to work with the Department of Health to move forward with convening a technical advisory committee to evaluate Wilson's Disease using the Board's process and criteria to evaluate conditions for inclusion in WAC 246-650-020 and then make a recommendation to the Board.

Motion/Second: Member Kutz/Member Love. Approved unanimously**.**

11. SCHOOL RULE REVIEW PROJECT UPDATE

Kate Dean, Board Member, introduced the School Rule Review project. Member Dean noted that this update intends to keep the Board informed of the project technical advisory committee (TAC) and the project team.

Andrew Kamali, Board staff, introduced new staff onboarded on June 16 who work on the School Rule Project. Crystal Ogle will provide administrative assistance. Mary Baechler will provide community outreach support. Marcus Dehart will provide communications support. Nina Helpling will serve as a policy advisor.

Andrew referenced items on file from the first project TAC meeting, which was held on August 1 in Wenatchee. There were 26 attendees and 22 were in-person. This meeting focused on the purpose of the TAC and set up the foundation for developing draft language. The TAC is comprised of a wide breadth of people – representing many sectors of education and public health, including parents. The TAC adopted dates for seven upcoming meetings. The August 22 meeting will take place at the Department of Health (Department) facilities in Tumwater. The September 17 meeting will co-locate with the Governor's Interagency Council on Health Disparities. The October 4 meeting will co-locate with the Environmental Health Directors meeting. Staff will post additional details on the Board's website.

Andrew stated the team is working to collaborate with community and sovereign Tribal partners. The team is also working with the Department to disseminate information about the TAC widely. The team is sharing information with local health jurisdictions (LHJs) and learning about their needs and connecting with school programs and the 295 school districts in Washington. There are over one million public school students in the state and approximately 500 private schools. Andrew stated the focus of the project is transparency and developing new standards.

Steve Kutz, Board Member, asked if there is a gap in knowledge about what is known about the project.

Andrew stated that there will likely always be gaps in knowledge regarding this project and that there is a Tribal partner/Tribal representative spot vacant on the TAC. Andrew stated the project does not necessarily impact Tribal school facilities but may still impact their students.

Member Kutz asked if there is a representative from the industry. Andrew said we are working with the industry for technical support and for information on how to fill gaps in the current rules. Member Kutz offered support to help fill the vacant Tribal representative spot on the TAC.

The Board took a break at 1:56 p.m. and reconvened at 2:10 p.m.

12. PRO-EQUITY ANTI-RACISM (PEAR) PLAN BRIEFING

Ashley Bell, Board staff, introduced the Pro-Equity Anti-Racism (PEAR) plan topic and shared a presentation on the topic (presentation on file). The presentation included background information on what a PEAR plan encompasses and how the Office of Equity is connected, current team progress to date, PEAR team creation and composition, and themes of the drafted PEAR plan. Ashley reviewed the drafted PEAR Plan, Goals 1 and 2 (on file). Ashley stated that the Culturally and Linguistically Appropriate Services (CLAS) assessment component will likely be conducted by a consultant.

Paj Nandi, Board Member, stated that the goals of this work are to continue focusing on what is within the Board's scope of influence and make the plan real and meaningful, operational, realistic and achievable.

Steve Kutz, Board Member, stated that community members are influential and informative in impacting Board decisions and larger government operations and hopes to see community involved in this process. Member Kutz also inquired about the Board's Tribal Liaison and available funding.

Member Nandi stated that we are looking into the work of the Tribal Liaison and that Ashley is the Board's Tribal Liaison. Ashley stated that we could do more with Tribal engagement and it is a priority in the PEAR plan.

Member Nandi stated that it is important to center the community when selecting presenters and asking that they present with an equity lens. Member Nandi reflected on the newborn screening presentation and there may have been more equity considerations to discuss on that meeting topic. Member Nandi stated that the intent is to include equity objectives in each conversation the Board has and in each person's role with the Board.

Kate Dean, Board Member, stated that the outreach conducted by Board staff on the State Health Report was informative and recommended institutionalizing more outreach in each meeting, including with a broader set of partners, stakeholders, Tribes, and additional people.

Member Kutz asked where the Governor's Interagency Council on Health Disparities fits into this topic and stated that there is more engagement happening with the Council. Michelle Davis, Executive Director, invited LinhPhung Huynh, Council Manager, to join the conversation and stated that the Board serves on the Council and helps to staff and support it. When the Council makes recommendations, those are brought before the Board. Executive Director Davis stated that Members could do more to share recommendations with agency leadership and that the Board could do more to connect Board and Council work.

LinhPhung Huynh, Council Manager, stated that community partners have recommended against collecting information from community partners if it has already been collected and those partners have already been asked to share information with government. For example, there is some information available through surveys collected by the Department of Health (Department) and others.

Kelly Oshiro, Board Vice Chair, asked what the CLAS assessment stands for. Ashley stated it means Culturally and Linguistically Appropriate Services and noted that will be updated with the definition in Board materials. Ashley added that Board Members may also want to understand the difference between a primary and secondary document, as referenced in materials, and stated this refers to whether the document is critical or not.

Vice Chair Oshiro asked what unregulated parties means. Ashley stated this refers to Tribes, people in the community who receive medical care, and additional technical voices.

Executive Director Davis referred to rule development and stated that state law is clear about the Board's obligation to include interested parties, but information from communities is often missing. Executive Director Davis prompted the Board to consider ways we must protect communities during rulemaking and asked how we can ensure we are hearing from diverse voices during our processes.

Vice Chair Oshiro asked about the PEAR plan tool to address likely equity impacts and requested to be made aware of the tool development. Vice Chair Oshiro also stated that a database to maintain outreach information will be useful as staff and Board Members transition, and requested information on how this information has been being stored.

Member Nandi stated that the HIR team is well-versed in looking at equity impacts, and that the PEAR team will assure that we use the most appropriate tool. Member Nandi stated this assessment may make the Board's work more time-consuming, but also more intentional.

Dr. Tao-Kwan-Gett, Secretary's Designee, stated that there are regional inequities across the state and that there is a need to build back trust in public health.

Member Kutz and Member Nandi identified an area of the PEAR materials that were provided by the Office of Equity.

Socia Love, Board Member, stated it can be challenging to engage with Tribes without placing a burden on them and that one way to navigate this is to hold events in Tribal communities. Member Love expressed appreciation for prior Board meetings that have been conducted in this way. Member Love also stated the importance of examining race and ethnicity data and appreciation for comments to stay patient with the PEAR process.

Dimyana Abdelmalek, Board Member, noted that many communities in Washington face disproportionate health risks. Member Abdelmalek expressed appreciation that the plan discusses disparities due to access, disparities data as a Board and larger public health system, how we collect data, and how we use specific instruments. Member Abdelmalek expressed availability to support this work.

Member Kutz stated that we may have more community participation if we held Board meetings in community spaces.

Ashley thanked the Board for the feedback and will follow up with some Board Members offline for further discussion.

13. RULES BRIEFING – ADDITION OF ORNITHINE TRANSCARBAMYLASE DEFICIENCY (OTCD), GUANIDINOACETATE METHYLTRANSFERASE (GAMT) DEFICIENCY, AND ARGINASE 1 DEFICIENCY (ARG1-D), CHAPTER 246-650 WAC, NEWBORN SCREENING

Kelly Oshiro, Board Vice Chair, introduced the Board's authority on newborn screening. Kelly discussed that the Board will convene a technical advisory committee (TAC) to determine which conditions to add to the Board's screening requirements.

Kelly Kramer, Board staff, noted that this is a rules briefing for adding Ornithine Transcarbamylase Deficiency (OTCD), Guanidinoacetate Methyltransferase Deficiency (GAMT), and Arginase 1 Deficiency (ARG1-D). Kelly proceeded to give an overview of each condition, screening and treatments available, and past work the Board has done on this topic (presentation on file).

John Thompson, Department staff, provided technical expertise.

Steve Kutz, Board Member, asked how can we start the testing without it being funded. John responded that there is a small amount of excess funding available to start this program before the funding increases. This allows us to start this sooner than next fall.

Member Kutz asked how we know if our predictions and assumptions about the impacts and costs of screening these conditions are true. How can we know if those assumptions were accurate. John responded that they met with the Board a few months ago to do an update on this program and have another annual update scheduled for next year. John offered to add a highlight for the new conditions (in the last five years or so) in next year's update.

Socia Love, Board Member, asked if we have a process for making sure that information is given back to the petitioner. Kelly responded that we do have a process for remaining in contact with petitioners and that we also continue to invite them to Board meetings.

14. BOARD MEMBER COMMENTS

Dr. Tao Kwan-Gett, Secretary's Designee**,** talked about finding your own apple—your own path to health; the things that make you healthy and happy. This theme comes from the Department of Health's (Department) new initiative Be Well WA. Member Kwan-Gett encouraged everyone to check out the website and shared a quote from it, saying it's an important initiative for the Department.

Socia Love, Board Member, shared about the annual canoe journey which just completed this week. Puyallup Tribe hosted the landing this year, with a focus on youth as sacred. Tribes put youth forward in the process. Fifty canoes landed in Tacoma, and many were filled with youth. Member Love said we talked a bit today about youth health and addiction prevention. This connects in as this entire ceremony was held as a drug and alcohol-free event. Member Love encouraged everyone to attend and watch the ceremony if possible. Many other communities came to be a part of it, for example, the Samoan community came to help bring in canoes this year.

ADJOURNMENT

Kelly Oshiro, Board Vice Chair, adjourned the meeting at 3:16 p.m.

WASHINGTON STATE BOARD OF HEALTH

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Kelly Oshiro, Vice Chair

To request this document in an alternate format or a different language, please contact the Washington State Board of Health at 360-236-4110 or by email at wsboh@sboh.wa.gov
TTY users can dial 711.

Public Comments

Received by Noon on Thursday, October 3, 2024

From: Gerald Steel
Sent: 9/28/2024 1:09:50 PM
To: Schut, Andy (DOH),Kwan-Gett, Tao (DOH),DOH Secretary's Office,DOH WSBOH
Subject: Federal Court finds 0.7 mg/L fluoridated water poses an "unreasonable risk" to public health [PART 3]

attachments\8D7FD9625D43449F_Health Impact Review (HIR) of SHB 1684.pdf

External Email

Mr. Schut, Mr. Kwan-Gett, Mr. Shah and other members of the Washington State Board of Health:

On September 24, 2024, a Federal District Court ("Court") found water fluoridation at 0.7 mg/L [as practiced in this State] poses an "unreasonable risk" to public health. Food & Water Watch, Inc. v. United States Envtl. Prot. Agency, 17-cv-02162-EMC | Casetext Search + Citator
<https://gcc02.safelinks.protection.outlook.com/?url=https%3A%2F%2Fcasetext.com%2Fcase%2Ffood-water-watch-inc-v-united-states-envtl-prot-agency-2&data=05%7C02%7Cwsboh%40sboh.wa.gov%7C76e7c0ac029d47aae2d708dcdff945f6%7C11d0e217264
The risk is to offspring of pregnant women who drank fluoridated water during pregnancy. The Court found there is an "unreasonable risk" that these offspring will have significantly reduced IQ because of 0.7 mg/L water fluoridation. On behalf of King County Citizens Against Fluoridation, I request emergency action to pause water fluoridation in this State until this risk is otherwise addressed.

While the Court mandated that U.S. EPA take regulatory action to eliminate this "unreasonable risk," I believe such regulatory action likely will take several years to complete. In the meantime, unless the State of Washington takes emergency action to pause water fluoridation, each year there will be about 37,000 more newborns in Washington subject to this "unreasonable risk" to their brains.

The 2022 Washington Dept. of Health ("WDOH") Health Impact Review of SHB 1684 ("HIR" attached hereto) at 7-8 states "45% of the state population" is served fluoridated water, and WDOH data states there were 83,314 births statewide in 2022. All Births Dashboard - County
<https://gcc02.safelinks.protection.outlook.com/?url=https%3A%2F%2Fdoh.wa.gov%2Fdata-and-statistical-reports%2Fwashington-tracking-network-wtn%2Fcounty-all-births-dashboard&data=05%7C02%7Cwsboh%40sboh.wa.gov%7C76e7c0ac029d47aae2d708dcdff945f6%7C11d0
So in 2022 about 45% of the 83,314 newborns (or 37,491 babies) were subject to this "unreasonable risk."

While the State can now do nothing to fix the reduced IQ of those whose brains have already been harmed by water fluoridation, it can now take emergency action to pause water fluoridation in Washington until the U.S. EPA takes action to eliminate this "unreasonable risk." There are only 41 water systems in Washington state that operate a community water fluoridation system. (HIR at 7) It would be relatively simple for all of these systems to pause water fluoridation. In most systems it would only require shutting a valve.

In my opinion, such an emergency pause in water fluoridation would not trigger the public notice required by RCW 70A.125.210 because an emergency pause would not be an action to discontinue fluoridation "on a continuing basis" and would not involve a local water system having a "vote or decision on the matter." I request the WDOH or the State Board of Health take the necessary emergency action.

Thank you. Please respond to this email with your opinion regarding the recommended way to implement such an emergency pause.

Gerald Steel RCE PE
Retired Attorney
7303 Young Rd. NW

Olympia WA 98502
Tel/Fax (360) 867-1166

Health Impact Review of SHB 1684
Concerning public health and fluoridation of drinking water (2022 Legislative Session)

February 8, 2022

Staff contact:
Lindsay Herendeen
Phone: (360) 628-6823
Email: lindsay.herendeen@sboh.wa.gov

Full review
The full Health Impact Review report is available at:
https://sboh.wa.gov/Portals/7/Doc/HealthImpactReviews/HIR-2022-04-HB1684.pdf

Acknowledgements
We would like to thank the key informants who provided consultation and technical support during this Health Impact Review.

Contents

Executive Summary
SHB 1684, Concerning public health and fluoridation of drinking water
(2022 Legislative Session)

Evidence indicates that SHB 1684 would likely result in Group A Water Systems serving 5,000 or more people per day that do not fluoridate conducting a cost analysis of community water fluoridation as part of water system planning, which would likely have no impact on community water fluoridation. The bill would also likely result in specified water systems seeking public health information and notifying customers prior to discontinuing community water fluoridation, and it is unclear how this would impact a water system's decision to discontinue or continue fluoridation. Based on these findings, the pathway to health impacts could not be completed.

BILL INFORMATION

Sponsors: Harris, Bateman, Fitzgibbon, Leavitt, Cody, Macri, Simmons, Pollet, Riccelli

Summary of Bill:

- Requires Group A Water Systems that serve 5,000 or more people per day and that do not currently fluoridate to conduct an analysis of the cost to design, install, operate, and maintain community water fluoridation when the system engages in water system planning. Allows other Group A water systems to elect into this requirement.
- Requires State Board of Health (SBOH) to adopt rules to support water systems to include community water fluoridation.
- Requires Washington State Department of Health (DOH) to create a program (subject to the availability of appropriated funding) within the Office of Drinking Water to provide engineering assistance to water systems related to upgrades, modifications, or expansions to implement or upgrade a community water fluoridation system, as long as the water system includes an engineering analysis. Allows DOH to receive funding from private sources to assist with this program.
- Requires Group A Water Systems that serve 5,000 or more people per day considering discontinuation of community water fluoridation to seek public health information from DOH and local health jurisdictions and to notify customers of this intention at least 90 days prior to a vote or decision to discontinue fluoridation. Allows other Group A water systems to elect into this requirement.
- Directs DOH to conduct an oral health equity assessment and provide recommendations to increase access to community water fluoridation to the Legislature by June 30, 2023.

HEALTH IMPACT REVIEW

Summary of Findings:
This Health Impact Review found the following evidence for provisions in SHB 1684:

Pathway 1: Cost analysis for community water fluoridation

- **Informed assumption** that requiring Group A Water Systems serving 5,000 or more people per day and that do not currently fluoridate to conduct an analysis of the cost to design, install, operate, and maintain community water fluoridation as part of water system planning would result in water systems conducting this cost analysis. This assumption is based on information from key informants representing water systems.
- **Informed assumption** that water systems conducting a cost analysis of community water fluoridation as part of water system planning would have no impact on community water fluoridation. This assumption is based on information from key informants representing water systems. Therefore, the pathway to health impacts could not be completed.

Pathway 2: Customer notification

- **Informed assumption** that requiring Group A Water Systems serving 5,000 or more people per day to seek public health information and notify customers 90 days prior to a vote or decision to discontinue community water fluoridation would result in water systems taking these actions before discontinuing community water fluoridation. This assumption is based on information from key informants representing water systems.
- **Unclear evidence** how seeking public health information and notifying customers 90 days prior to a vote or decision to discontinue community water fluoridation would impact a water system’s decision to discontinue or continue fluoridation due to variations in water system governance and political and community contexts. Therefore, the pathway to health impacts could not be completed.

Introduction and Methods

A Health Impact Review is an analysis of how a proposed legislative or budgetary change will likely impact health and health disparities in Washington State (RCW 43.20.285). For the purpose of this review 'health disparities' have been defined as differences in disease, death, and other adverse health conditions that exist between populations (RCW 43.20.270). Differences in health conditions are not intrinsic to a population; rather, inequities are related to social determinants (e.g., access to healthcare, economic stability, racism). This document provides summaries of the evidence analyzed by State Board of Health staff during the Health Impact Review of Substitute House Bill 1684 (SHB 1684).

Staff analyzed the content of SHB 1684 and created a logic model depicting possible pathways leading from the provisions of the bill to health outcomes. We consulted with experts and contacted key informants about the provisions and potential impacts of the bill. We conducted an objective review of published literature for each pathway using databases including PubMed, Google Scholar, and University of Washington Libraries. We evaluated evidence using set criteria and determined a strength-of-evidence for each step in the pathway. More information about key informants and detailed methods are available upon request.

The following pages provide a detailed analysis of the bill, including the logic model, summaries of evidence, and annotated references. The logic model is presented both in text and through a flowchart (Figure 1). The logic model includes information on the strength-of-evidence for each pathway. The strength-of-evidence has been established using set criteria and summarized as:

- **Very strong evidence:** There is a very large body of robust, published evidence and some qualitative primary research with all or almost all evidence supporting the association. There is consensus between all data sources and types, indicating that the premise is well accepted by the scientific community.
- **Strong evidence:** There is a large body of published evidence and some qualitative primary research with the majority of evidence supporting the association, though some sources may have less robust study design or execution. There is consensus between data sources and types.
- **A fair amount of evidence:** There is some published evidence and some qualitative primary research with the majority of evidence supporting the association. The body of evidence may include sources with less robust design and execution and there may be some level of disagreement between data sources and types.
- **Expert opinion:** There is limited or no published evidence; however, rigorous qualitative primary research is available supporting the association, with an attempt to include viewpoints from multiple types of informants. There is consensus among the majority of informants.
- **Informed assumption:** There is limited or no published evidence; however, some qualitative primary research is available. Rigorous qualitative primary research was not possible due to time or other constraints. There is consensus among the majority of informants.

- **No association:** There is some published evidence and some qualitative primary research with the majority of evidence supporting no association or no relationship. The body of evidence may include sources with less robust design and execution and there may be some level of disagreement between data sources and types.
- **Not well researched:** There is limited or no published evidence and limited or no qualitative primary research and the body of evidence has inconsistent or mixed findings, with some supporting the association, some disagreeing, and some finding no connection. There is a lack of consensus between data sources and types.
- **Unclear:** There is a lack of consensus between data sources and types, and the directionality of the association is ambiguous due to potential unintended consequences or other variables.

This review was completed during Legislative Session and was subject to the 10-day turnaround required in statute. This review was subject to time constraints, which influenced the scope of work for this review. The annotated references are only a representation of the evidence and provide examples of current research. In some cases, only a few review articles or meta-analyses are referenced. One article may cite or provide analysis of dozens of other articles. Therefore, the number of references included in the bibliography does not necessarily reflect the strength-of-evidence. In addition, some articles provide evidence for more than one research question, so are referenced multiple times.

Analysis of SHB 1684 and the Scientific Evidence

Summary of relevant background information

- Fluoride is a naturally-occurring mineral commonly found in soil, water, and plants.[1] People typically consume fluoride from fluoridated drinking water, foods and beverages prepared with fluoridated drinking water, and toothpaste and other dental products that contain fluoride.[1]
- The 1974 Safe Drinking Water Act (SDWA) regulates public drinking water supplies to protect public health.[2] The SDWA authorized the U.S. Environmental Protection Agency (U.S. EPA) "to set national health-based standards for drinking water to protect against both naturally-occurring and man-made contaminants that may be found in drinking water."[2]
    - Under the SDWA, fluoride is regulated as an inorganic chemical contaminant, with a maximum contaminant level (MCL) of 4 milligrams per liter (mg/L) to protect human health.[3] MCLs are enforceable under federal regulations.[3]
    - Community water fluoridation is not required under federal law.
- The U.S. Public Health Service's (PHS) recommended fluoride concentration in drinking water is 0.7 mg/L "to prevent tooth decay in children and adults while reducing the risks for children to develop dental fluorosis."[4] This concentration was updated in 2015.[4] The PHS recommendation is not an enforceable federal regulation.[4]
    - Healthy People 2030 states that, "[f]luoride can stop or even reverse the tooth decay process — it can help re-mineralize tooth surfaces and prevent cavities from forming."[5] According to the Surgeon General's 2021 report *Oral Health in America: Advances and Challenges*, "[a]lthough dental caries is largely preventable, if untreated it can lead to pain, inflammation, and the spread of infection to bone and soft tissue."[6] Dental caries are one of the most common chronic diseases across the lifespan.[6,7]
- Under RCW 43.20.050, the Washington State Board of Health (SBOH) has the authority to maintain the state's rules related to public drinking water systems, including requirements that Group A Water Systems must meet to provide safe and reliable public drinking water and to protect public health.
    - WAC 246-290-460 pertains to the fluoridation of drinking water.[8] In 2016, SBOH updated the rule to reflect the updated 0.7 mg/L recommended fluoride concentration. The rule sets related requirements for monitoring, record keeping, and reporting.[8] The rule specifies that water systems must obtain approval from the Washington State Department of Health (DOH) before implementing community water fluoridation and notify DOH before discontinuing fluoridation.[8]
- Community water fluoridation is not required in Washington State.[9]
- Chapter 70A.125 RCW specifies that public drinking water systems must comply with all applicable federal, state, and local rules.[10] The statute outlines requirements for public drinking water systems, including planning for operating, maintenance, and future growth of public water system facilities.[10] The rule defines a public water system as "any system, excluding a system serving only one single-family residence and a system with four or

fewer connections all of which serve residences on the same farm, providing water for human consumption through pipes or other constructed conveyances."[10] Further:
  - Group A Water Systems are those "with [15] or more service connections, regardless of the number of people; or a system serving an average of [25] or more people per day for [60] or more days within a calendar year, regardless of the number of service connections; or a system serving [1,000] or more people for [2] or more consecutive days."[10]
  - Group B Water Systems are those that do not meet the definition of a Group A Water System.[10]
- WAC 246-290-100 requires a Group A community water system to submit a Water System Plan (WSP) if it serves 1,000 or more connections, is a new Group A Water System, or proposes changes to expand or increase connections or geography not previously approved.[11] The purpose of a WSP is to demonstrate system capacity as defined in WAC 246-290-010, explain how the water system will address present and future needs, and establish eligibility for funding.[11]
- Four states require notification of the public or customers prior to discontinuing community water fluoridation:
  - Iowa (House File 390, effective 2021)[12] and Missouri (Chapter 640.136, effective 2016)[13] require a water system to notify customers 90 days prior to taking a vote or action to discontinue community water fluoridation.
  - Tennessee (Code § 68-221-708, effective 2019) requires a water system to notify customers 30 days prior to a vote to discontinue community water fluoridation.[14]
  - New York State (N.Y. Public Health § 1100-a, effective 2015) requires a water system to notify the public prior to discontinuing community water fluoridation and to provide justification for discontinuing fluoridation, available alternatives to fluoridation, and a summary of public health information.[15]

Summary of SHB 1684

- Requires Group A Water Systems that serve 5,000 or more people per day and that do not currently fluoridate to conduct an analysis of the cost to design, install, operate, and maintain community water fluoridation when the system engages in water system planning. Allows other Group A water systems to elect into this requirement.
- Requires SBOH to adopt rules to support water systems to include community water fluoridation. Rules must specify the:
  - Recommended fluoride concentration to be maintained by the water system; and
  - Procedures to maintain the recommended concentration of fluoride, including treatment facilities; cost-benefit analysis of start-up costs; recordkeeping, reporting, and testing requirements; and enforcement procedures.
- Requires DOH to create a program (subject to the availability of appropriated funding) within the Office of Drinking Water to provide engineering assistance to water systems related to upgrades, modifications, or expansions to implement or upgrade a community water fluoridation system, as long as the water system includes an engineering analysis. Allows DOH to receive funding from private sources to assist with this program.

- Requires Group A Water Systems that serve 5,000 or more people per day considering discontinuation of community water fluoridation to seek public health information from DOH and local health jurisdictions and to notify customers of this intention at least 90 days prior to a vote or decision to discontinue fluoridation. Allows other Group A water systems to elect into this requirement.
    - Specifies that public notification must include language approved by DOH about the public health impacts of fluoride and be disseminated through radio, television, newspaper, mail, electronic means, or any combination of methods.
    - States that any water system that violates notification requirements must continue community water fluoridation until provisions are met.
- Directs DOH to conduct an oral health equity assessment and provide recommendations to increase access to community water fluoridation to the Legislature by June 30, 2023.

Health impact of SHB 1684

Evidence indicates that SHB 1684 would likely result in Group A Water Systems serving 5,000 or more people per day that do not fluoridate conducting a cost analysis of community water fluoridation as part of water system planning, which would likely have no impact on community water fluoridation. The bill would also likely result in specified water systems seeking public health information and notifying customers prior to discontinuing community water fluoridation, and it is unclear how this would impact a water system's decision to discontinue or continue fluoridation. Based on these findings, the pathway to health impacts could not be completed.

Pathway to health impacts

The potential pathway leading from the provisions of SHB 1684 to decreased health inequities are depicted in Figure 1.

Pathway 1: Cost analysis for community water fluoridation

We have made the informed assumption that requiring Group A Water Systems serving 5,000 or more people per day and that do not currently fluoridate to conduct an analysis of the cost to design, install, operate, and maintain community water fluoridation as part of water system planning would result in water systems conducting this cost analysis. We have also made the informed assumption that water systems conducting a cost analysis of community water fluoridation as part of water system planning would have no impact on community water fluoridation. Both assumptions are based on information from key informants representing water systems. Since we have made the informed assumption that conducting a cost analysis would not impact community water fluoridation, the pathway to health impacts could not be completed.

Pathway 2: Customer notification

We have also made the informed assumption that requiring Group A Water Systems serving 5,000 or more people per day to seek public health information and notify customers 90 days prior to a vote or decision to discontinue community water fluoridation would result in water systems taking these actions before discontinuing community water fluoridation. This assumption is based on information from key informants representing water systems. There is unclear evidence how seeking public health information and notifying customers 90 days prior to a vote or decision to discontinue community water fluoridation would impact a water system's decision to discontinue or continue fluoridation due to variations in water system governance and political and community contexts. Since it is unclear how seeking public health information and notifying customers would impact a water system's decision to continue or discontinue fluoridation, the pathway to health impacts could not be completed.

Scope
Due to time limitations, we only researched the most direct connections between provisions of the bill and health inequities and did not explore the evidence for all possible pathways. For example, we did not evaluate potential impacts related to:

- Costs related to SBOH rulemaking.
- Requirements that DOH create a program to provide engineering technical assistance related to fluoridation implementation. SHB 1684 stipulates that this provision is subject to the appropriation of funds and that water systems would need to provide an engineering analysis to work with DOH in this capacity. DOH currently provides technical assistance for water systems, especially to support water systems as they prepare for and complete water system planning (personal communication, DOH, February 2022).
- Requirements that DOH conduct an oral health equity assessment.

Magnitude of impact
SHB 1684 would impact Group A Water Systems serving 5,000 or more people per day. Other Group A Water Systems would be able to elect to meet requirements in the bill. Therefore, SHB 1684 has the potential to impact all Group A state-regulated water systems in Washington State. Provisions of the bill would not apply to Group B Water Systems, tribal water systems, or private water supplies.

There are 17,657 water systems in Washington State; 4,146 of these systems are Group A Water Systems (unpublished data, DOH, February 2022). Of the 4,146 Group A Water Systems:

- 2,216 are community water systems (i.e., with [15] or more service connections, regardless of the number of people);
- 1,615 are transient, non-community water systems (i.e., serving 25 or more people per day for 60 or more days within a calendar year or 1,000 or more people for 2 or more consecutive days [e.g., a gas station, campground, fairground]); and,
- 315 are non-transient, non-community water systems (i.e., serving 25 or more of the same people per day for 180 or more days within a calendar year, regardless of the number of service connections [e.g., a school]) (unpublished data, DOH, February 2022).

There are 160 Group A Water Systems serving 5,000 or more people per day in Washington State. These systems serve a total of 5,732,548 people (74% of the state population) (unpublished data, DOH, February 2022). Of these Group A Water Systems, 64 systems (40%) provide fluoridated water to their customers (unpublished data, DOH, February 2022). Specifically, 41 water systems operate a community water fluoridation system and 23 additional water systems receive fluoridated water through intertie systems (i.e., purchasing water from another system that fluoridates) (unpublished data, DOH, February 2022). Combined, these

Group A Water Systems serve a full-time residential population of 3,456,942 (45% of the state population) (unpublished data, DOH, February 2022).

The range of people living in Washington State receiving fluoridated drinking water varies by county. In some counties, as few as 2% of people receive fluoridated water.[16] In other counties, 80% of people receive fluoridated water.[16] Nineteen counties have at least 1 Group A Water System that provides fluoridated water.[16] Naturally-occurring fluoride is common in parts of Eastern Washington.[16] Two water systems reduce natural fluoride to reach the recommended fluoride concentration of 0.7 mg/L, including 1 system that removes fluoride from the water system and 1 that blends water sources (unpublished data, DOH, February 2022).

While the provisions of SHB 1684 specifies a certain subset of Group A Water Systems that must meet each requirement, the bill has the potential to impact all Group A state-regulated water systems.

Logic Model

Pathway 1: Cost analysis for community water fluoridation

Requires specified water systems to conduct an analysis of the cost to design, install, operate, and maintain community water fluoridation as part of water system planning

Water systems conduct a cost analysis of community water fluoridation as part of water system planning

No impact on community water fluoridation

Since we have made the informed assumption that conducting a cost analysis would not impact community water fluoridation, the pathway to health impacts could not be completed.

See discussion in Summaries of Findings.

Pathway 2: Customer notification

Requires specified water systems to seek public health information and notify customers 90 days prior to a vote or decision to discontinue community water fluoridation

Water systems seek public health information and notify customers prior to discontinuing community water fluoridation

Water systems decide whether to continue or discontinue community water fluoridation*

Since it is unclear how seeking public health information and notifying customers would impact a water system's decision to continue or discontinue fluoridation, the pathway to health impacts could not be completed.

See discussion in Summaries of Findings.

Key
- Very strong
- Strong
- A fair amount
- Expert opinion
- Informed assumption
- Not well researched
- Unclear *

Figure 1:

Concerning public health and fluoridation of drinking water

SHB 1684

Summaries of Findings

Pathway 1: Cost analysis for community water fluoridation

Would requiring specified water systems to conduct an analysis of the cost to design, install, operate, and maintain community water fluoridation as part of water system planning result in water systems conducting this cost analysis?

We have made the informed assumption that requiring Group A Water Systems serving 5,000 or more people per day and that do not currently fluoridate to conduct an analysis of the cost to design, install, operate, and maintain community water fluoridation as part of water system planning would result in water systems conducting this cost analysis. This assumption is based on information from key informants representing water systems, including 3 people representing 3 water system associations (which each represent multiple water systems) and 4 people representing 3 individual water systems. Key informants represented a variety of water systems, including small and large systems and systems that do and do not currently provide community water fluoridation.

Under Washington State law, Group A Water Systems must submit a Water System Plan (WSP) to the Washington State Department of Health (DOH) for review and approval.[17] Once approved, the WSP is effective for up to 10 years unless DOH requests an updated plan.[17] DOH guidance notes that "[s]ome WSP elements are best developed by water system staff, while other plan elements must be completed by a [licensed Professional Engineer]" as required by WAC 246-290-040.[17] Although some water systems employ engineers who can do this work, many systems contract with engineering firms to complete engineering components of their WSP (personal communications, February 2022).

Provisions of SHB 1684 would require Group A Water Systems serving 5,000 or more people per day and that do not currently fluoridate to conduct an analysis of the cost to design, install, operate, and maintain community water fluoridation as part of water system planning. The bill does not require water systems to consider benefits to public health or potential healthcare cost savings across the lifespan as part of this cost analysis. There are 119 Group A Water Systems serving 5,000 or more people per day that do not currently fluoridate (unpublished data, DOH, February 2022). However, 23 of these are intertied systems that provide fluoridated water to their customers by purchasing water from fluoridated systems (unpublished data, DOH, February 2022). Therefore, 96 Group A Water Systems serving 5,000 or more people per day do not currently fluoridate and would be required to meet this bill provision.

The bill also directs the State Board of Health (SBOH) to modify rules to support water systems to include community water fluoridation. Specifically, rules must include the recommended fluoride concentration as well as standards and procedures for maintaining the recommended fluoride concentration (i.e., necessary treatment facilities; a cost-benefit analysis of estimated capital start-up costs; record keeping, reporting, and testing requirements; and enforcement procedures). Key informants noted that SBOH rules already address many of the elements listed in the bill (e.g., recommended fluoride concentration; monitoring, record keeping, and reporting requirements) (personal communications, February 2022).

If passed, key informants expect that most water systems would contract out the required analysis to an engineering firm, which may be an added cost for water system planning (personal communication, February 2022). Most Group A Water Systems have multiple water sources (an average of 2 sources per system, ranging from 1 to 65 sources per system), including both surface water and groundwater sources (personal communications, February 2022). In instances where sources are interconnected, it may be possible for water systems to fluoridate at a single point. However, in many cases, sources may need to be treated individually (personal communications, February 2022). Water systems will likely need to contract with an engineering firm to determine the appropriate design, process, and equipment needs for a fluoridation system (personal communications, February 2022). The cost of this work would likely vary by the size, capacity, and complexity of a water system (personal communications, February 2022).

The associated planning costs may also depend on whether an in-depth analysis is required or if a general estimate from a consultant is acceptable (personal communications, February 2022). For example, key informants noted a cost-benefit analysis could consider questions, including: what type of fluoridation system would make the most sense for the system (e.g., based on water source and chemistry); where would the equipment go; what types of space would be required; could the system be added to an existing structure; what equipment costs are involved; what maintenance is required; what type of monitoring would be required; are there security requirements; what energy costs are expected; and how much does fluoride cost? (personal communications, February 2022). Alternatively, the analysis could involve a few general assumptions to inform a high-level estimate (personal communications, February 2022). The Local Government Fiscal Note on the original version of the bill indicated that "the amount of additional work would vary between jurisdictions due to size of the jurisdiction, experience in similar kinds of analyses […] Therefore, the increase [in cost] to local government expenditures cannot be determined at this time."[18]

Lastly, key informants would not expect systems to conduct a cost analysis for community water fluoridation unless required to do so (personal communications, February 2022). Therefore, they would expect few, if any, systems not required by provisions in the bill to elect into this requirement (personal communications, February 2022). All key informants agreed that Group A Water Systems serving less than 5,000 people per day would not elect into provisions requiring an analysis of the cost to design, install, operate, and maintain community water fluoridation (personal communications, February 2022).

Overall, all key informants agreed that, if SHB 1684 were passed, Group A Water Systems serving 5,000 or more people per day and that do not currently fluoridate would conduct a cost analysis of community water fluoridation to meet the requirement.

Would water systems conducting this cost analysis impact community water fluoridation?
We have made the informed assumption that water systems conducting a cost analysis of community water fluoridation as part of water system planning would have no impact on community water fluoridation. This informed assumption is based on information from key informants representing a variety of water systems.

SHB 1684 does not require community water fluoridation, and all key informants representing water systems stated that conducting a cost analysis would not result in a water system implementing community water fluoridation (personal communications, February 2022). While some key informants felt that a cost analysis could be necessary to inform future decision-making about community water fluoridation, all key informants stated that a cost analysis alone would be insufficient to result in a water system implementing community water fluoridation (personal communications, February 2022). One water system stated that, "absent a need or requirement to fluoridate either from a regulatory requirement, a policymaker decision, or a customer demand for it, it seems unlikely that conducting such an analysis alone would result in a water system implementing fluoridation" (personal communication, February 2022). Other key informants stated that water systems would not implement fluoridation unless required or mandated at the local, state, or federal level (personal communication, February 2022).

Since we have made the informed assumption that conducting a cost analysis would not impact community water fluoridation, the pathway to health impacts could not be completed.

Pathway 2: Customer notification

Would requiring specified water systems to seek public health information and notify customers 90 days prior to a vote or decision to discontinue community water fluoridation result in water systems taking these actions before discontinuing community water fluoridation?

We have made the informed assumption that requiring Group A Water Systems serving 5,000 or more people per day to seek public health information and notify customers 90 days prior to a vote or decision to discontinue community water fluoridation would result in water systems taking these actions before discontinuing fluoridation. This assumption is based on information from key informants representing a variety of water systems.

Under current Washington State law, a water system that decides to discontinue a community water fluoridation program is required to notify DOH.[8] Provisions in SHB 1684 would require Group A Water Systems serving 5,000 or more people per day that are considering discontinuation of community water fluoridation to seek related public health information about community water fluoridation from DOH or local health jurisdictions. Water systems would also be required to notify customers at least 90 days prior to a vote or decision to discontinue fluoridation and provide the results of the public health findings to customers. There are 64 Group A Water Systems serving 5,000 or more people per day that currently fluoridate (unpublished data, DOH, February 2022) and would need to meet these requirements if they were to consider discontinuing fluoridation.

Key informants stated that water systems typically have established working relationships with DOH and local heath jurisdictions. For example, water systems must work with DOH on a variety of reporting and monitoring procedures. Key informants explained that water systems work with local health jurisdictions around various water quality topics (boil water advisories, use of emergency water supplies, etc.) and are familiar with seeking public health information and language to inform public notification (personal communications, February 2022). Moreover, key informants felt that water systems that currently fluoridate are likely already aware of public health information related to community water fluoridation (personal communications, February 2022). However, water systems expressed differing views on whether public health was a part of their mission (personal communications, February 2022), so the relationship with DOH and local health jurisdiction may vary by water system.

Key informants noted there may be specific instances that could result in consideration of discontinuation of community water fluoridation (e.g., aging structures and associated maintenance costs) (personal communications, February 2022). However, most key informants felt it is unlikely that water systems currently providing community water fluoridation would choose to discontinue fluoridation (personal communications, February 2022). Since 2013, 2 Group A Water Systems serving 5,000 or more people per day have discontinued community water fluoridation as a result of political or community actions (personal communication, February 2022).

Since all key informants stated that water systems would meet these provisions if required, we have made the informed assumption that requiring Group A Water Systems serving 5,000 or more people per day to seek public health information and notify customers 90 days prior to a vote or decision to discontinue community water fluoridation would result in water systems taking these actions before discontinuing community water fluoridation.

Would seeking public health information and notifying customers 90 days prior to a vote or decision to discontinue community water fluoridation impact a water system's decision to discontinue fluoridation?

There is unclear evidence for how seeking public health information and notifying customers 90 days prior to a vote or decision to discontinue community water fluoridation would impact a water system's decision to discontinue or continue fluoridation due to variations in water system governance and political and community contexts.

Generally, key informants felt that requiring customer notification 90 days prior to a vote or decision to discontinue fluoridation could inform or be considered in a water system's decision-making (personal communication, February 2022). However, key informants emphasized that authorizing environment and governance structure varies by water system, so the extent to which public input could impact decision-making would be difficult to quantify as decision-making and public involvement varies by governance structure (personal communications, February 2022). One water system stated that their governance structure would require a citizen's initiative for the water system to discontinue fluoridation (personal communication, February 2022). Another system stated that decisions about fluoridation would require a vote by an elected board that represents the community served by the water system (personal communication, February 2022). Yet another stated that, "if we already had the infrastructure for fluoridation in place, we would only discontinue fluoridation if we were regulated to do so" (personal communication, February 2022). Therefore, how a water system is structured and makes decisions may impact the extent to which public input is considered in the decision-making process.

Similarly, key informants also explained that, under some governance structures, not all customers may be able to impact decisions as some communities receive water from a system outside of their jurisdiction (personal communications, February 2022). For example, Tacoma

Public Utilities and Seattle Public Utilities provide water to some areas of Pierce and King Counties outside of their respective city limits. Under the provisions of SHB 1684, a water system would only be required to provide notification to the city or municipality purchasing their water as a customer. For instance, the City of Bellevue is intertied with Seattle Public Utilities and is their customer. The bill language would require Seattle Public Utilities to notify City of Bellevue before discontinuing fluoridation but would not require notification of customers receiving water from the City of Bellevue. Another water system shared that, if their system were considering a change, not all customers in the system would be represented in a vote, as some customers live outside of city limits (personal communication, February 2022). However, key informants felt that most water systems, especially systems serving 5,000 or more customers per day, would likely provide notification to all water system users regardless of the bill provisions (personal communication, February 2022). However, customers receiving water through intertied systems may not be able to vote or otherwise influence a water system's decision to discontinue or continue fluoridation unless the water system chose an approach that engaged those customers (personal communication, February 2022).

All key informants emphasized that community water fluoridation is a polarizing topic for communities (personal communications, February 2022). Key informants shared that public opinion on community water fluoridation has changed over time and varies community to community (personal communications, February 2022). A media article cited a report by the Centers for Disease Control and Prevention (CDC) which documented the history of fluoride referendums nationally and the fluctuation of support and opposition for community water fluordiation.[19] Their analysis found that 41% of proposed referendums related to fluoride were adopted in the 1950s and 1960s, 36% were adopted in the 1980s, 59% were adopted in the 1990s, and 39% were adopted in the 2000s.[19] Therefore, a water system's decision to discontinue or continue water fluoridation would likely depend in part on public opinion and whether the community was vested in discontinuing or continuing community water fluoridation.

Since customer notification and input may vary by governance structure and since public opinion may influence the directionality of a water system's decision to discontinue or continue fluoridation, it is unclear how seeking public health information and notifying customers 90 days prior to a vote or decision to discontinue community water fluoridation would impact a water system's decision to discontinue or continue fluoridation. Therefore, the pathway to health impacts could not be completed.

Annotated References

1. **Fluoride: Fact Sheet for Health Professionals. 2021; Available at: https://ods.od.nih.gov/factsheets/Fluoride-HealthProfessional/. Accessed 1/31/2022.**
The National Institutes of Health, Office of Dietary Supplements maintains a fact sheet about fluoride for health professionals, including background information, recommended intake levels, health benefits and risks, and dietary sources of fluoride.

2. **Overview of the Safe Drinking Water Act. 2021; Available at: https://www.epa.gov/sdwa/overview-safe-drinking-water-act. Accessed 1/31/2022.**
The U.S. Environmental Protection Agency (U.S. EPA) provides information about the 1974 Safe Drinking Water Act.

3. **National Primary Drinking Water Regulations. 2021; Available at: https://www.epa.gov/ground-water-and-drinking-water/national-primary-drinking-water-regulations. Accessed 1/31/2022.**
The U.S. Environmental Protection Agency (U.S. EPA) outlines contaminants regulated by the National Primary Drinking Water Regulations, including fluoride.

4. **Community Water Fluoridation--Public Health Service Recommendation. 2021; Available at: https://www.cdc.gov/fluoridation/faqs/public-service-recommendations.html. Accessed 1/31/2022.**
The U.S. Public Health Services recommended concentration of fluoride in drinking water is 0.7 mg/L "to prevent tooth decay in children and adults while reducing the risks for children to develop dental fluorosis."

5. **Healthy People 2030: Increase the proportion of people whose water systems have the recommended amount of fluoride -- OH-11. 2020; Available at: https://health.gov/healthypeople/objectives-and-data/browse-objectives/health-policy/increase-proportion-people-whose-water-systems-have-recommended-amount-fluoride-oh-11. Accessed 2/3/2022.**
Healthy People 2030 provides background information about tooth decay and fluoride.

6. **Murthy V.H., Collins F.S., D'Souza R. Oral Health in America: Advances and Challenges. National Institutes of Health; December 2021.**
This 2021 follow up to the Surgeon General's 2000 Report on Oral Health in America explores oral health in the U.S. over the last 20 years. It is the result of two years of research and the work of more than 400 contributors.

7. **U.S. Department of Health & Human Services. Oral Health Conditions. 2020; Available at: https://www.cdc.gov/oralhealth/conditions/index.html. Accessed 3 February, 2022.**
This CDC web page provides a high-level overview of oral health conditions including cavities (tooth decay), gum (periodontal) disease, and oral cancer. For example, while "cavities are largely preventable, they are one of the most common chronic diseases throughout the lifespan."

It also notes that "[o]ral conditions are frequently considered separate from other chronic conditions, but these are actually inter-related."

8. **Washington State Board of Health. WAC 246-290-460 Group A Public Water Supplies, Part 5. Water System Operations, Fluoridation of drinking water. 2019.**
WAC 246-290-460 pertains to the fluoridation of drinking water.

9. **Washington State Department of Health, Office of Drinking Water. Fluoride: Is my drinking water fluoridated? Tumwater, WA. 2018.**
The document is a public-facing Question & Answer resource regarding fluoridated water in Washington State.

10. **Washington State Legislature. Chapter 70A.125 RCW--PUBLIC WATER SYSTEMS—PENALTIES AND COMPLIANCE. 2020.**
Chapter 70A.125 RCW outlines requirements for public drinking water systems.

11. **WAC 246-290-100 Group A Public Water Supplies, Part 2. Engineering and Planning Documents, Water system plan.**
WAS 246-290-100 pertains to requirements for water system plans.

12. **State of Iowa General Assembly. House File 390, An act relating to notice requirements prior to discontinuing fluoridation in a public water supply system. 2021.**
Iowa House File 390 requires water systems to notify customers 90 days prior to discontinuing community water fluoridation.

13. **Missouri General Assembly. Chapter 640.136. Fluoridation modification, notification to department and customers. 2016.**
Under Missouri law Chapter 640.136. Fluoridation modification, notification to department and customers, water systems are required to notify customers 90 days prior to a vote to modify community water fluoridation.

14. **State of Tennessee. Code 68-221-708 Notification to public and regulatory agencies. 2021.**
Tennessee Code 68-221-708 requires water systems to notify the public 30 days prior to discontinuing community water fluoridation.

15. **New York State Senate. Public Health Chapter 45, Article 11, Title 1: Section 1100-A Fluoridation. 2015.**
In 2015, New York State passed Public Health Chapter 45, Article 11, Title 1: Section 1100-A Fluoridation. Among other provisions, the law outlines requirements for public notification prior to discontinuing community water fluoridation.

16. **Washington State Department of Health, Office of Drinking Water. Fluoridated Drinking Water, 2018 Washington State Health Assessment. Tumwater, WA. 2018.**
The document provides an overview of fluoridation in Washington State's drinking water.

17. **Washington State Department of Health, Office of Drinking Water. Water System Planning Guidebook. Tumwater, WA. 2020.**
The Guidebook is a resource for developing Water System Plans covering technical, managerial, and financial elements.

18. **Duncan R. Local Government Fiscal Note - HB 1684 Concerning public health and fluoridation of drinking water. Olympia, WA: Washington State Office of Financial Management; 2022.**
Department of Commerce prepared The Local Government Fiscal Note included in the Multiple Agency Fiscal Note for HB 1684, Concerning public health and fluoridation of drinking water. The analysis determined that the legislative impacts for cities and special districts would result in an indeterminate increase in expenditures for municipal water systems and public utilities due to additional work on fluoridation analyses. Specifically, "[t]he amount of additional work would vary between jurisdictions due to the size of jurisdiction, experience in similar kinds of analyses...Therefore, the increase to local government expenditures cannot be determined at this time."

19. **Kliff S. A brief history of America's fluoride wars. *The Washington Post.* May 21, 2013, 2013; Economic Policy.**
The article discussed the controversy surrounding the use of fluoride in community water systems. The article cited a CDC report on fluoridation referendums, reporting that between 1950 and 1967 there were 1,009 fluoridation referendums across the United States. 41% of fluoride proposals were adopted and 59% were rejected. From 1980 to 1988 there were 150 fluoridation votes. 36% of fluoride proposals adopted and 64% were rejected. During the 1990s, of 32 referendums conducted, 59% of fluoride proposals were adopted and 41% were rejected. During the 2000 election cycle, there were 23 fluoridation ballot initiatives. 39% were adopted and 61% were rejected. San Antonio, TX and Clark County, NV passed fluoride referendums during the 2000 election cycle. The percentage of people in the United States receiving fluoridated water by community water systems increased from 62% in 1992 to 69% in 2006.

From: Gerald Steel
Sent: 9/28/2024 1:52:23 PM
To:
tips@komonews.com,fox13tips@fox.com,investigations@seattletimes.com,news@spokesman.com,newstips

Subject: Federal Court finds 0.7 mg/L fluoridated water poses an "unreasonable risk" to public health [PART 4]

attachments\6CEDC14F07534486_Health Impact Review (HIR) of SHB 1684.pdf

External Email

Below is a copy of an email sent to WDOH and WSBOH. The important information is that pregnant women or women who might be pregnant should not drink fluoridated water because of an "unreasonable risk" of their offspring having significantly reduced IQ. 45% of the state population receives fluoridated water. People can call their water provider to find out if their water is fluoridated or you can show a statewide map of fluoridated systems. Fluoridation of Drinking Water
<https://gcc02.safelinks.protection.outlook.com/?url=https%3A%2F%2Fdoh.wa.gov%2Fcommunity-and-environment%2Fdrinking-water%2Ffluoride-drinking-water&data=05%7C02%7Cwsboh%40sboh.wa.gov%7C08f5421ae7964d634abf08dcdfff3a95%7C11d0e217

<https://gcc02.safelinks.protection.outlook.com/?url=https%3A%2F%2Fdoh.wa.gov%2Fcommunity-and-environment%2Fdrinking-water%2Ffluoride-drinking-water&data=05%7C02%7Cwsboh%40sboh.wa.gov%7C08f5421ae7964d634abf08dcdfff3a95%7C11d0e217

Fluoridation of Drinking Water

Washington State does not require public water systems to add fluoride to drinking water. The decision to fluori...

Gerald Steel RCE PE

Retired Attorney
7303 Young Rd. NW

Olympia WA 98502
Tel/Fax (360) 867-1166

On Saturday, September 28, 2024 at 01:05:09 PM PDT, Gerald Steel <geraldsteel@yahoo.com> wrote:

Mr. Schut, Mr. Kwan-Gett, Mr. Shah and other members of the Washington State Board of Health:

On September 24, 2024, a Federal District Court ("Court") found water fluoridation at 0.7 mg/L [as practiced in this State] poses an "unreasonable risk" to public health. Food & Water Watch, Inc. v. United States Envtl. Prot. Agency, 17-cv-02162-EMC | Casetext

Search + Citator
<https://gcc02.safelinks.protection.outlook.com/?url=https%3A%2F%2Fcasetext.com%2Fcase%2Ffood-water-watch-inc-v-united-states-envtl-prot-agency-2&data=05%7C02%7Cwsboh%40sboh.wa.gov%7C08f5421ae7964d634abf08dcdfff3a95%7C11d0e217264
The risk is to offspring of pregnant women who drank fluoridated water during pregnancy. The Court found there is an "unreasonable risk" that these offspring will have significantly reduced IQ because of 0.7 mg/L water fluoridation. On behalf of King County Citizens Against Fluoridation, I request emergency action to pause water fluoridation in this State until this risk is otherwise addressed.

While the Court mandated that U.S. EPA take regulatory action to eliminate this "unreasonable risk," I believe such regulatory action likely will take several years to complete. In the meantime, unless the State of Washington takes emergency action to pause water fluoridation, each year there will be about 37,000 more newborns in Washington subject to this "unreasonable risk" to their brains.

The 2022 Washington Dept. of Health ("WDOH") Health Impact Review of SHB 1684 ("HIR" attached hereto) at 7-8 states "45% of the state population" is served fluoridated water, and WDOH data states there were 83,314 births statewide in 2022. All Births Dashboard - County
<https://gcc02.safelinks.protection.outlook.com/?url=https%3A%2F%2Fdoh.wa.gov%2Fdata-and-statistical-reports%2Fwashington-tracking-network-wtn%2Fcounty-all-births-dashboard&data=05%7C02%7Cwsboh%40sboh.wa.gov%7C08f5421ae7964d634abf08dcdfff3a95%7C11d0
So in 2022 about 45% of the 83,314 newborns (or 37,491 babies) were subject to this "unreasonable risk."

While the State can now do nothing to fix the reduced IQ of those whose brains have already been harmed by water fluoridation, it can now take emergency action to pause water fluoridation in Washington until the U.S. EPA takes action to eliminate this "unreasonable risk." There are only 41 water systems in Washington state that operate a community water fluoridation system. (HIR at 7) It would be relatively simple for all of these systems to pause water fluoridation. In most systems it would only require shutting a valve.

In my opinion, such an emergency pause in water fluoridation would not trigger the public notice required by RCW 70A.125.210 because an emergency pause would not be an action to discontinue fluoridation "on a continuing basis" and would not involve a local water system having a "vote or decision on the matter." I request the WDOH or the State Board of Health take the necessary emergency action.

Thank you. Please respond to this email with your opinion regarding the recommended way to implement such an emergency pause.

Gerald Steel RCE PE
Retired Attorney
7303 Young Rd. NW

Olympia WA 98502
Tel/Fax (360) 867-1166

Health Impact Review of SHB 1684
Concerning public health and fluoridation of drinking water (2022 Legislative Session)

February 8, 2022

Staff contact:
Lindsay Herendeen
Phone: (360) 628-6823
Email: lindsay.herendeen@sboh.wa.gov

Full review

The full Health Impact Review report is available at:

https://sboh.wa.gov/Portals/7/Doc/HealthImpactReviews/HIR-2022-04-HB1684.pdf

Acknowledgements

We would like to thank the key informants who provided consultation and technical support during this Health Impact Review.

Contents

Executive Summary
SHB 1684, Concerning public health and fluoridation of drinking water
(2022 Legislative Session)

Evidence indicates that SHB 1684 would likely result in Group A Water Systems serving 5,000 or more people per day that do not fluoridate conducting a cost analysis of community water fluoridation as part of water system planning, which would likely have no impact on community water fluoridation. The bill would also likely result in specified water systems seeking public health information and notifying customers prior to discontinuing community water fluoridation, and it is unclear how this would impact a water system's decision to discontinue or continue fluoridation. Based on these findings, the pathway to health impacts could not be completed.

BILL INFORMATION

Sponsors: Harris, Bateman, Fitzgibbon, Leavitt, Cody, Macri, Simmons, Pollet, Riccelli

Summary of Bill:

- Requires Group A Water Systems that serve 5,000 or more people per day and that do not currently fluoridate to conduct an analysis of the cost to design, install, operate, and maintain community water fluoridation when the system engages in water system planning. Allows other Group A water systems to elect into this requirement.
- Requires State Board of Health (SBOH) to adopt rules to support water systems to include community water fluoridation.
- Requires Washington State Department of Health (DOH) to create a program (subject to the availability of appropriated funding) within the Office of Drinking Water to provide engineering assistance to water systems related to upgrades, modifications, or expansions to implement or upgrade a community water fluoridation system, as long as the water system includes an engineering analysis. Allows DOH to receive funding from private sources to assist with this program.
- Requires Group A Water Systems that serve 5,000 or more people per day considering discontinuation of community water fluoridation to seek public health information from DOH and local health jurisdictions and to notify customers of this intention at least 90 days prior to a vote or decision to discontinue fluoridation. Allows other Group A water systems to elect into this requirement.
- Directs DOH to conduct an oral health equity assessment and provide recommendations to increase access to community water fluoridation to the Legislature by June 30, 2023.

HEALTH IMPACT REVIEW

Summary of Findings:
This Health Impact Review found the following evidence for provisions in SHB 1684:

Pathway 1: Cost analysis for community water fluoridation

- **Informed assumption** that requiring Group A Water Systems serving 5,000 or more people per day and that do not currently fluoridate to conduct an analysis of the cost to design, install, operate, and maintain community water fluoridation as part of water system planning would result in water systems conducting this cost analysis. This assumption is based on information from key informants representing water systems.
- **Informed assumption** that water systems conducting a cost analysis of community water fluoridation as part of water system planning would have no impact on community water fluoridation. This assumption is based on information from key informants representing water systems. Therefore, the pathway to health impacts could not be completed.

Pathway 2: Customer notification

- **Informed assumption** that requiring Group A Water Systems serving 5,000 or more people per day to seek public health information and notify customers 90 days prior to a vote or decision to discontinue community water fluoridation would result in water systems taking these actions before discontinuing community water fluoridation. This assumption is based on information from key informants representing water systems.
- **Unclear evidence** how seeking public health information and notifying customers 90 days prior to a vote or decision to discontinue community water fluoridation would impact a water system's decision to discontinue or continue fluoridation due to variations in water system governance and political and community contexts. Therefore, the pathway to health impacts could not be completed.

Introduction and Methods

A Health Impact Review is an analysis of how a proposed legislative or budgetary change will likely impact health and health disparities in Washington State (RCW 43.20.285). For the purpose of this review 'health disparities' have been defined as differences in disease, death, and other adverse health conditions that exist between populations (RCW 43.20.270). Differences in health conditions are not intrinsic to a population; rather, inequities are related to social determinants (e.g., access to healthcare, economic stability, racism). This document provides summaries of the evidence analyzed by State Board of Health staff during the Health Impact Review of Substitute House Bill 1684 (SHB 1684).

Staff analyzed the content of SHB 1684 and created a logic model depicting possible pathways leading from the provisions of the bill to health outcomes. We consulted with experts and contacted key informants about the provisions and potential impacts of the bill. We conducted an objective review of published literature for each pathway using databases including PubMed, Google Scholar, and University of Washington Libraries. We evaluated evidence using set criteria and determined a strength-of-evidence for each step in the pathway. More information about key informants and detailed methods are available upon request.

The following pages provide a detailed analysis of the bill, including the logic model, summaries of evidence, and annotated references. The logic model is presented both in text and through a flowchart (Figure 1). The logic model includes information on the strength-of-evidence for each pathway. The strength-of-evidence has been established using set criteria and summarized as:

- **Very strong evidence:** There is a very large body of robust, published evidence and some qualitative primary research with all or almost all evidence supporting the association. There is consensus between all data sources and types, indicating that the premise is well accepted by the scientific community.
- **Strong evidence:** There is a large body of published evidence and some qualitative primary research with the majority of evidence supporting the association, though some sources may have less robust study design or execution. There is consensus between data sources and types.
- **A fair amount of evidence:** There is some published evidence and some qualitative primary research with the majority of evidence supporting the association. The body of evidence may include sources with less robust design and execution and there may be some level of disagreement between data sources and types.
- **Expert opinion:** There is limited or no published evidence; however, rigorous qualitative primary research is available supporting the association, with an attempt to include viewpoints from multiple types of informants. There is consensus among the majority of informants.
- **Informed assumption:** There is limited or no published evidence; however, some qualitative primary research is available. Rigorous qualitative primary research was not possible due to time or other constraints. There is consensus among the majority of informants.

- **No association:** There is some published evidence and some qualitative primary research with the majority of evidence supporting no association or no relationship. The body of evidence may include sources with less robust design and execution and there may be some level of disagreement between data sources and types.
- **Not well researched:** There is limited or no published evidence and limited or no qualitative primary research and the body of evidence has inconsistent or mixed findings, with some supporting the association, some disagreeing, and some finding no connection. There is a lack of consensus between data sources and types.
- **Unclear:** There is a lack of consensus between data sources and types, and the directionality of the association is ambiguous due to potential unintended consequences or other variables.

This review was completed during Legislative Session and was subject to the 10-day turnaround required in statute. This review was subject to time constraints, which influenced the scope of work for this review. The annotated references are only a representation of the evidence and provide examples of current research. In some cases, only a few review articles or meta-analyses are referenced. One article may cite or provide analysis of dozens of other articles. Therefore, the number of references included in the bibliography does not necessarily reflect the strength-of-evidence. In addition, some articles provide evidence for more than one research question, so are referenced multiple times.

Analysis of SHB 1684 and the Scientific Evidence

Summary of relevant background information

- Fluoride is a naturally-occurring mineral commonly found in soil, water, and plants.[1] People typically consume fluoride from fluoridated drinking water, foods and beverages prepared with fluoridated drinking water, and toothpaste and other dental products that contain fluoride.[1]
- The 1974 Safe Drinking Water Act (SDWA) regulates public drinking water supplies to protect public health.[2] The SDWA authorized the U.S. Environmental Protection Agency (U.S. EPA) "to set national health-based standards for drinking water to protect against both naturally-occurring and man-made contaminants that may be found in drinking water."[2]
  - Under the SDWA, fluoride is regulated as an inorganic chemical contaminant, with a maximum contaminant level (MCL) of 4 milligrams per liter (mg/L) to protect human health.[3] MCLs are enforceable under federal regulations.[3]
  - Community water fluoridation is not required under federal law.
- The U.S. Public Health Service's (PHS) recommended fluoride concentration in drinking water is 0.7 mg/L "to prevent tooth decay in children and adults while reducing the risks for children to develop dental fluorosis."[4] This concentration was updated in 2015.[4] The PHS recommendation is not an enforceable federal regulation.[4]
  - Healthy People 2030 states that, "[f]luoride can stop or even reverse the tooth decay process — it can help re-mineralize tooth surfaces and prevent cavities from forming."[5] According to the Surgeon General's 2021 report *Oral Health in America: Advances and Challenges*, "[a]lthough dental caries is largely preventable, if untreated it can lead to pain, inflammation, and the spread of infection to bone and soft tissue."[6] Dental caries are one of the most common chronic diseases across the lifespan.[6,7]
- Under RCW 43.20.050, the Washington State Board of Health (SBOH) has the authority to maintain the state's rules related to public drinking water systems, including requirements that Group A Water Systems must meet to provide safe and reliable public drinking water and to protect public health.
  - WAC 246-290-460 pertains to the fluoridation of drinking water.[8] In 2016, SBOH updated the rule to reflect the updated 0.7 mg/L recommended fluoride concentration. The rule sets related requirements for monitoring, record keeping, and reporting.[8] The rule specifies that water systems must obtain approval from the Washington State Department of Health (DOH) before implementing community water fluoridation and notify DOH before discontinuing fluoridation.[8]
- Community water fluoridation is not required in Washington State.[9]
- Chapter 70A.125 RCW specifies that public drinking water systems must comply with all applicable federal, state, and local rules.[10] The statute outlines requirements for public drinking water systems, including planning for operating, maintenance, and future growth of public water system facilities.[10] The rule defines a public water system as "any system, excluding a system serving only one single-family residence and a system with four or

fewer connections all of which serve residences on the same farm, providing water for human consumption through pipes or other constructed conveyances."[10] Further:

  - Group A Water Systems are those "with [15] or more service connections, regardless of the number of people; or a system serving an average of [25] or more people per day for [60] or more days within a calendar year, regardless of the number of service connections; or a system serving [1,000] or more people for [2] or more consecutive days."[10]
  - Group B Water Systems are those that do not meet the definition of a Group A Water System.[10]

- WAC 246-290-100 requires a Group A community water system to submit a Water System Plan (WSP) if it serves 1,000 or more connections, is a new Group A Water System, or proposes changes to expand or increase connections or geography not previously approved.[11] The purpose of a WSP is to demonstrate system capacity as defined in WAC 246-290-010, explain how the water system will address present and future needs, and establish eligibility for funding.[11]
- Four states require notification of the public or customers prior to discontinuing community water fluoridation:
  - Iowa (House File 390, effective 2021)[12] and Missouri (Chapter 640.136, effective 2016)[13] require a water system to notify customers 90 days prior to taking a vote or action to discontinue community water fluoridation.
  - Tennessee (Code § 68-221-708, effective 2019) requires a water system to notify customers 30 days prior to a vote to discontinue community water fluoridation.[14]
  - New York State (N.Y. Public Health § 1100-a, effective 2015) requires a water system to notify the public prior to discontinuing community water fluoridation and to provide justification for discontinuing fluoridation, available alternatives to fluoridation, and a summary of public health information.[15]

Summary of SHB 1684

- Requires Group A Water Systems that serve 5,000 or more people per day and that do not currently fluoridate to conduct an analysis of the cost to design, install, operate, and maintain community water fluoridation when the system engages in water system planning. Allows other Group A water systems to elect into this requirement.
- Requires SBOH to adopt rules to support water systems to include community water fluoridation. Rules must specify the:
  - Recommended fluoride concentration to be maintained by the water system; and
  - Procedures to maintain the recommended concentration of fluoride, including treatment facilities; cost-benefit analysis of start-up costs; recordkeeping, reporting, and testing requirements; and enforcement procedures.
- Requires DOH to create a program (subject to the availability of appropriated funding) within the Office of Drinking Water to provide engineering assistance to water systems related to upgrades, modifications, or expansions to implement or upgrade a community water fluoridation system, as long as the water system includes an engineering analysis. Allows DOH to receive funding from private sources to assist with this program.

- Requires Group A Water Systems that serve 5,000 or more people per day considering discontinuation of community water fluoridation to seek public health information from DOH and local health jurisdictions and to notify customers of this intention at least 90 days prior to a vote or decision to discontinue fluoridation. Allows other Group A water systems to elect into this requirement.
  - Specifies that public notification must include language approved by DOH about the public health impacts of fluoride and be disseminated through radio, television, newspaper, mail, electronic means, or any combination of methods.
  - States that any water system that violates notification requirements must continue community water fluoridation until provisions are met.
- Directs DOH to conduct an oral health equity assessment and provide recommendations to increase access to community water fluoridation to the Legislature by June 30, 2023.

Health impact of SHB 1684

Evidence indicates that SHB 1684 would likely result in Group A Water Systems serving 5,000 or more people per day that do not fluoridate conducting a cost analysis of community water fluoridation as part of water system planning, which would likely have no impact on community water fluoridation. The bill would also likely result in specified water systems seeking public health information and notifying customers prior to discontinuing community water fluoridation, and it is unclear how this would impact a water system's decision to discontinue or continue fluoridation. Based on these findings, the pathway to health impacts could not be completed.

Pathway to health impacts

The potential pathway leading from the provisions of SHB 1684 to decreased health inequities are depicted in Figure 1.

Pathway 1: Cost analysis for community water fluoridation

We have made the informed assumption that requiring Group A Water Systems serving 5,000 or more people per day and that do not currently fluoridate to conduct an analysis of the cost to design, install, operate, and maintain community water fluoridation as part of water system planning would result in water systems conducting this cost analysis. We have also made the informed assumption that water systems conducting a cost analysis of community water fluoridation as part of water system planning would have no impact on community water fluoridation. Both assumptions are based on information from key informants representing water systems. Since we have made the informed assumption that conducting a cost analysis would not impact community water fluoridation, the pathway to health impacts could not be completed.

Pathway 2: Customer notification

We have also made the informed assumption that requiring Group A Water Systems serving 5,000 or more people per day to seek public health information and notify customers 90 days prior to a vote or decision to discontinue community water fluoridation would result in water systems taking these actions before discontinuing community water fluoridation. This assumption is based on information from key informants representing water systems. There is unclear evidence how seeking public health information and notifying customers 90 days prior to a vote or decision to discontinue community water fluoridation would impact a water system's decision to discontinue or continue fluoridation due to variations in water system governance and political and community contexts. Since it is unclear how seeking public health information and notifying customers would impact a water system's decision to continue or discontinue fluoridation, the pathway to health impacts could not be completed.

Scope

Due to time limitations, we only researched the most direct connections between provisions of the bill and health inequities and did not explore the evidence for all possible pathways. For example, we did not evaluate potential impacts related to:

- Costs related to SBOH rulemaking.
- Requirements that DOH create a program to provide engineering technical assistance related to fluoridation implementation. SHB 1684 stipulates that this provision is subject to the appropriation of funds and that water systems would need to provide an engineering analysis to work with DOH in this capacity. DOH currently provides technical assistance for water systems, especially to support water systems as they prepare for and complete water system planning (personal communication, DOH, February 2022).
- Requirements that DOH conduct an oral health equity assessment.

Magnitude of impact

SHB 1684 would impact Group A Water Systems serving 5,000 or more people per day. Other Group A Water Systems would be able to elect to meet requirements in the bill. Therefore, SHB 1684 has the potential to impact all Group A state-regulated water systems in Washington State. Provisions of the bill would not apply to Group B Water Systems, tribal water systems, or private water supplies.

There are 17,657 water systems in Washington State; 4,146 of these systems are Group A Water Systems (unpublished data, DOH, February 2022). Of the 4,146 Group A Water Systems:

- 2,216 are community water systems (i.e., with [15] or more service connections, regardless of the number of people);
- 1,615 are transient, non-community water systems (i.e., serving 25 or more people per day for 60 or more days within a calendar year or 1,000 or more people for 2 or more consecutive days [e.g., a gas station, campground, fairground]); and,
- 315 are non-transient, non-community water systems (i.e., serving 25 or more of the same people per day for 180 or more days within a calendar year, regardless of the number of service connections [e.g., a school]) (unpublished data, DOH, February 2022).

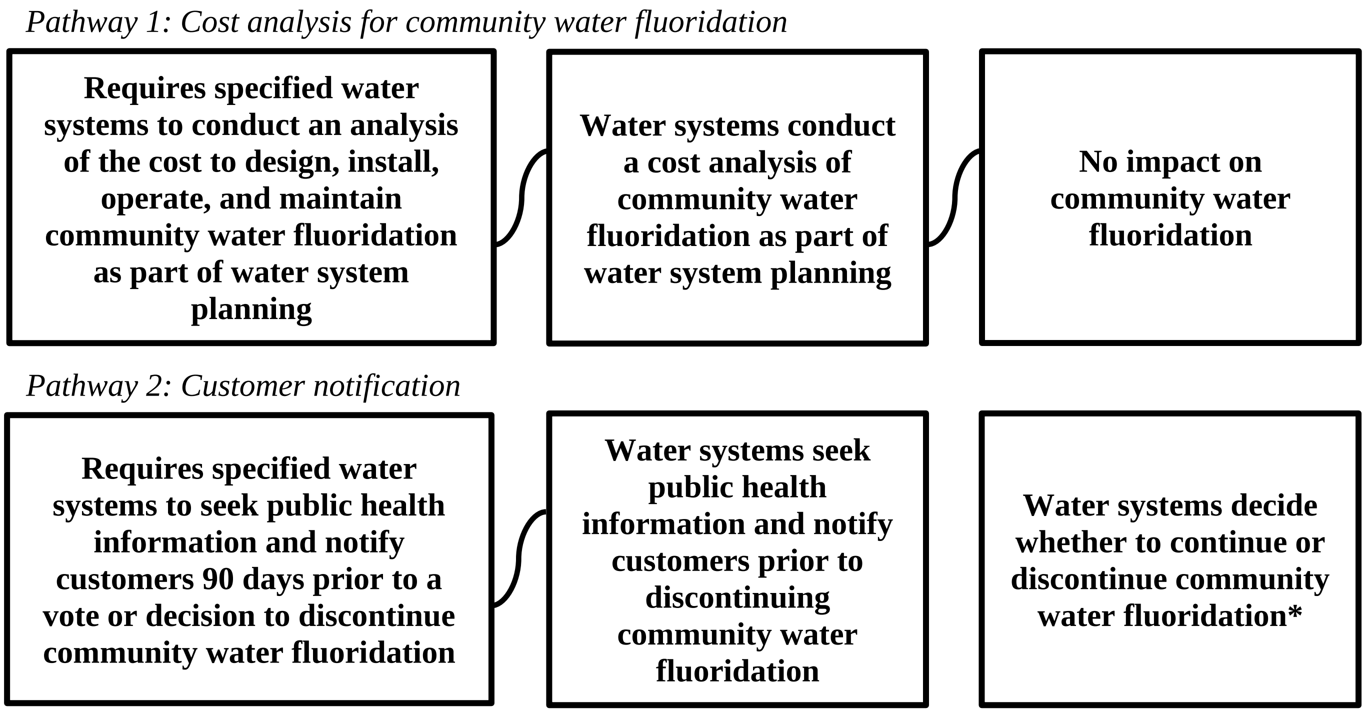
There are 160 Group A Water Systems serving 5,000 or more people per day in Washington State. These systems serve a total of 5,732,548 people (74% of the state population) (unpublished data, DOH, February 2022). Of these Group A Water Systems, 64 systems (40%) provide fluoridated water to their customers (unpublished data, DOH, February 2022). Specifically, 41 water systems operate a community water fluoridation system and 23 additional water systems receive fluoridated water through intertie systems (i.e., purchasing water from another system that fluoridates) (unpublished data, DOH, February 2022). Combined, these

Group A Water Systems serve a full-time residential population of 3,456,942 (45% of the state population) (unpublished data, DOH, February 2022).

The range of people living in Washington State receiving fluoridated drinking water varies by county. In some counties, as few as 2% of people receive fluoridated water.[16] In other counties, 80% of people receive fluoridated water.[16] Nineteen counties have at least 1 Group A Water System that provides fluoridated water.[16] Naturally-occurring fluoride is common in parts of Eastern Washington.[16] Two water systems reduce natural fluoride to reach the recommended fluoride concentration of 0.7 mg/L, including 1 system that removes fluoride from the water system and 1 that blends water sources (unpublished data, DOH, February 2022).

While the provisions of SHB 1684 specifies a certain subset of Group A Water Systems that must meet each requirement, the bill has the potential to impact all Group A state-regulated water systems.

Logic Model



Since we have made the informed assumption that conducting a cost analysis would not impact community water fluoridation, the pathway to health impacts could not be completed.

See discussion in Summaries of Findings.

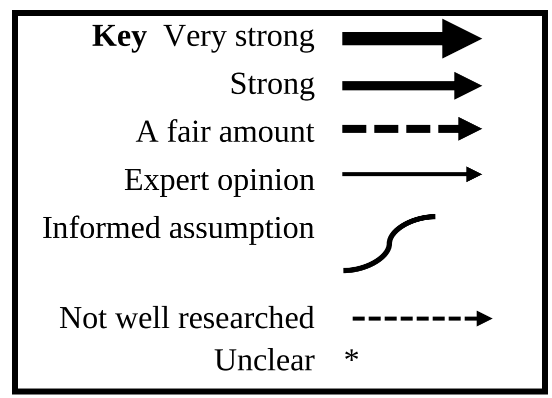
Since it is unclear how seeking public health information and notifying customers would impact a water system's decision to continue or discontinue fluoridation, the pathway to health impacts could not be completed.

See discussion in Summaries of Findings.

Figure 1:

Concerning public health and fluoridation of drinking water

SHB 1684



Summaries of Findings

Pathway 1: Cost analysis for community water fluoridation

Would requiring specified water systems to conduct an analysis of the cost to design, install, operate, and maintain community water fluoridation as part of water system planning result in water systems conducting this cost analysis?

We have made the informed assumption that requiring Group A Water Systems serving 5,000 or more people per day and that do not currently fluoridate to conduct an analysis of the cost to design, install, operate, and maintain community water fluoridation as part of water system planning would result in water systems conducting this cost analysis. This assumption is based on information from key informants representing water systems, including 3 people representing 3 water system associations (which each represent multiple water systems) and 4 people representing 3 individual water systems. Key informants represented a variety of water systems, including small and large systems and systems that do and do not currently provide community water fluoridation.

Under Washington State law, Group A Water Systems must submit a Water System Plan (WSP) to the Washington State Department of Health (DOH) for review and approval.[17] Once approved, the WSP is effective for up to 10 years unless DOH requests an updated plan.[17] DOH guidance notes that "[s]ome WSP elements are best developed by water system staff, while other plan elements must be completed by a [licensed Professional Engineer]" as required by WAC 246-290-040.[17] Although some water systems employ engineers who can do this work, many systems contract with engineering firms to complete engineering components of their WSP (personal communications, February 2022).

Provisions of SHB 1684 would require Group A Water Systems serving 5,000 or more people per day and that do not currently fluoridate to conduct an analysis of the cost to design, install, operate, and maintain community water fluoridation as part of water system planning. The bill does not require water systems to consider benefits to public health or potential healthcare cost savings across the lifespan as part of this cost analysis. There are 119 Group A Water Systems serving 5,000 or more people per day that do not currently fluoridate (unpublished data, DOH, February 2022). However, 23 of these are intertied systems that provide fluoridated water to their customers by purchasing water from fluoridated systems (unpublished data, DOH, February 2022). Therefore, 96 Group A Water Systems serving 5,000 or more people per day do not currently fluoridate and would be required to meet this bill provision.

The bill also directs the State Board of Health (SBOH) to modify rules to support water systems to include community water fluoridation. Specifically, rules must include the recommended fluoride concentration as well as standards and procedures for maintaining the recommended fluoride concentration (i.e., necessary treatment facilities; a cost-benefit analysis of estimated capital start-up costs; record keeping, reporting, and testing requirements; and enforcement procedures). Key informants noted that SBOH rules already address many of the elements listed in the bill (e.g., recommended fluoride concentration; monitoring, record keeping, and reporting requirements) (personal communications, February 2022).

If passed, key informants expect that most water systems would contract out the required analysis to an engineering firm, which may be an added cost for water system planning (personal communication, February 2022). Most Group A Water Systems have multiple water sources (an average of 2 sources per system, ranging from 1 to 65 sources per system), including both surface water and groundwater sources (personal communications, February 2022). In instances where sources are interconnected, it may be possible for water systems to fluoridate at a single point. However, in many cases, sources may need to be treated individually (personal communications, February 2022). Water systems will likely need to contract with an engineering firm to determine the appropriate design, process, and equipment needs for a fluoridation system (personal communications, February 2022). The cost of this work would likely vary by the size, capacity, and complexity of a water system (personal communications, February 2022).

The associated planning costs may also depend on whether an in-depth analysis is required or if a general estimate from a consultant is acceptable (personal communications, February 2022). For example, key informants noted a cost-benefit analysis could consider questions, including: what type of fluoridation system would make the most sense for the system (e.g., based on water source and chemistry); where would the equipment go; what types of space would be required; could the system be added to an existing structure; what equipment costs are involved; what maintenance is required; what type of monitoring would be required; are there security requirements; what energy costs are expected; and how much does fluoride cost? (personal communications, February 2022). Alternatively, the analysis could involve a few general assumptions to inform a high-level estimate (personal communications, February 2022). The Local Government Fiscal Note on the original version of the bill indicated that "the amount of additional work would vary between jurisdictions due to size of the jurisdiction, experience in similar kinds of analyses […] Therefore, the increase [in cost] to local government expenditures cannot be determined at this time."[18]

Lastly, key informants would not expect systems to conduct a cost analysis for community water fluoridation unless required to do so (personal communications, February 2022). Therefore, they would expect few, if any, systems not required by provisions in the bill to elect into this requirement (personal communications, February 2022). All key informants agreed that Group A Water Systems serving less than 5,000 people per day would not elect into provisions requiring an analysis of the cost to design, install, operate, and maintain community water fluoridation (personal communications, February 2022).

Overall, all key informants agreed that, if SHB 1684 were passed, Group A Water Systems serving 5,000 or more people per day and that do not currently fluoridate would conduct a cost analysis of community water fluoridation to meet the requirement.

Would water systems conducting this cost analysis impact community water fluoridation?
We have made the informed assumption that water systems conducting a cost analysis of community water fluoridation as part of water system planning would have no impact on community water fluoridation. This informed assumption is based on information from key informants representing a variety of water systems.

SHB 1684 does not require community water fluoridation, and all key informants representing water systems stated that conducting a cost analysis would not result in a water system implementing community water fluoridation (personal communications, February 2022). While some key informants felt that a cost analysis could be necessary to inform future decision-making about community water fluoridation, all key informants stated that a cost analysis alone would be insufficient to result in a water system implementing community water fluoridation (personal communications, February 2022). One water system stated that, “absent a need or requirement to fluoridate either from a regulatory requirement, a policymaker decision, or a customer demand for it, it seems unlikely that conducting such an analysis alone would result in a water system implementing fluoridation” (personal communication, February 2022). Other key informants stated that water systems would not implement fluoridation unless required or mandated at the local, state, or federal level (personal communication, February 2022).

Since we have made the informed assumption that conducting a cost analysis would not impact community water fluoridation, the pathway to health impacts could not be completed.

Pathway 2: Customer notification

Would requiring specified water systems to seek public health information and notify customers 90 days prior to a vote or decision to discontinue community water fluoridation result in water systems taking these actions before discontinuing community water fluoridation?

We have made the informed assumption that requiring Group A Water Systems serving 5,000 or more people per day to seek public health information and notify customers 90 days prior to a vote or decision to discontinue community water fluoridation would result in water systems taking these actions before discontinuing fluoridation. This assumption is based on information from key informants representing a variety of water systems.

Under current Washington State law, a water system that decides to discontinue a community water fluoridation program is required to notify DOH.[8] Provisions in SHB 1684 would require Group A Water Systems serving 5,000 or more people per day that are considering discontinuation of community water fluoridation to seek related public health information about community water fluoridation from DOH or local health jurisdictions. Water systems would also be required to notify customers at least 90 days prior to a vote or decision to discontinue fluoridation and provide the results of the public health findings to customers. There are 64 Group A Water Systems serving 5,000 or more people per day that currently fluoridate (unpublished data, DOH, February 2022) and would need to meet these requirements if they were to consider discontinuing fluoridation.

Key informants stated that water systems typically have established working relationships with DOH and local heath jurisdictions. For example, water systems must work with DOH on a variety of reporting and monitoring procedures. Key informants explained that water systems work with local health jurisdictions around various water quality topics (boil water advisories, use of emergency water supplies, etc.) and are familiar with seeking public health information and language to inform public notification (personal communications, February 2022). Moreover, key informants felt that water systems that currently fluoridate are likely already aware of public health information related to community water fluoridation (personal communications, February 2022). However, water systems expressed differing views on whether public health was a part of their mission (personal communications, February 2022), so the relationship with DOH and local health jurisdiction may vary by water system.

Key informants noted there may be specific instances that could result in consideration of discontinuation of community water fluoridation (e.g., aging structures and associated maintenance costs) (personal communications, February 2022). However, most key informants felt it is unlikely that water systems currently providing community water fluoridation would choose to discontinue fluoridation (personal communications, February 2022). Since 2013, 2 Group A Water Systems serving 5,000 or more people per day have discontinued community water fluoridation as a result of political or community actions (personal communication, February 2022).

Since all key informants stated that water systems would meet these provisions if required, we have made the informed assumption that requiring Group A Water Systems serving 5,000 or more people per day to seek public health information and notify customers 90 days prior to a vote or decision to discontinue community water fluoridation would result in water systems taking these actions before discontinuing community water fluoridation.

Would seeking public health information and notifying customers 90 days prior to a vote or decision to discontinue community water fluoridation impact a water system's decision to discontinue fluoridation?

There is unclear evidence for how seeking public health information and notifying customers 90 days prior to a vote or decision to discontinue community water fluoridation would impact a water system's decision to discontinue or continue fluoridation due to variations in water system governance and political and community contexts.

Generally, key informants felt that requiring customer notification 90 days prior to a vote or decision to discontinue fluoridation could inform or be considered in a water system's decision-making (personal communication, February 2022). However, key informants emphasized that authorizing environment and governance structure varies by water system, so the extent to which public input could impact decision-making would be difficult to quantify as decision-making and public involvement varies by governance structure (personal communications, February 2022). One water system stated that their governance structure would require a citizen's initiative for the water system to discontinue fluoridation (personal communication, February 2022). Another system stated that decisions about fluoridation would require a vote by an elected board that represents the community served by the water system (personal communication, February 2022). Yet another stated that, "if we already had the infrastructure for fluoridation in place, we would only discontinue fluoridation if we were regulated to do so" (personal communication, February 2022). Therefore, how a water system is structured and makes decisions may impact the extent to which public input is considered in the decision-making process.

Similarly, key informants also explained that, under some governance structures, not all customers may be able to impact decisions as some communities receive water from a system outside of their jurisdiction (personal communications, February 2022). For example, Tacoma

Public Utilities and Seattle Public Utilities provide water to some areas of Pierce and King Counties outside of their respective city limits. Under the provisions of SHB 1684, a water system would only be required to provide notification to the city or municipality purchasing their water as a customer. For instance, the City of Bellevue is intertied with Seattle Public Utilities and is their customer. The bill language would require Seattle Public Utilities to notify City of Bellevue before discontinuing fluoridation but would not require notification of customers receiving water from the City of Bellevue. Another water system shared that, if their system were considering a change, not all customers in the system would be represented in a vote, as some customers live outside of city limits (personal communication, February 2022). However, key informants felt that most water systems, especially systems serving 5,000 or more customers per day, would likely provide notification to all water system users regardless of the bill provisions (personal communication, February 2022). However, customers receiving water through intertied systems may not be able to vote or otherwise influence a water system's decision to discontinue or continue fluoridation unless the water system chose an approach that engaged those customers (personal communication, February 2022).

All key informants emphasized that community water fluoridation is a polarizing topic for communities (personal communications, February 2022). Key informants shared that public opinion on community water fluoridation has changed over time and varies community to community (personal communications, February 2022). A media article cited a report by the Centers for Disease Control and Prevention (CDC) which documented the history of fluoride referendums nationally and the fluctuation of support and opposition for community water fluordiation.[19] Their analysis found that 41% of proposed referendums related to fluoride were adopted in the 1950s and 1960s, 36% were adopted in the 1980s, 59% were adopted in the 1990s, and 39% were adopted in the 2000s.[19] Therefore, a water system's decision to discontinue or continue water fluoridation would likely depend in part on public opinion and whether the community was vested in discontinuing or continuing community water fluoridation.

Since customer notification and input may vary by governance structure and since public opinion may influence the directionality of a water system's decision to discontinue or continue fluoridation, it is unclear how seeking public health information and notifying customers 90 days prior to a vote or decision to discontinue community water fluoridation would impact a water system's decision to discontinue or continue fluoridation. Therefore, the pathway to health impacts could not be completed.

Annotated References

1. **Fluoride: Fact Sheet for Health Professionals. 2021; Available at: https://ods.od.nih.gov/factsheets/Fluoride-HealthProfessional/. Accessed 1/31/2022.**
The National Institutes of Health, Office of Dietary Supplements maintains a fact sheet about fluoride for health professionals, including background information, recommended intake levels, health benefits and risks, and dietary sources of fluoride.

2. **Overview of the Safe Drinking Water Act. 2021; Available at: https://www.epa.gov/sdwa/overview-safe-drinking-water-act. Accessed 1/31/2022.**
The U.S. Environmental Protection Agency (U.S. EPA) provides information about the 1974 Safe Drinking Water Act.

3. **National Primary Drinking Water Regulations. 2021; Available at: https://www.epa.gov/ground-water-and-drinking-water/national-primary-drinking-water-regulations. Accessed 1/31/2022.**
The U.S. Environmental Protection Agency (U.S. EPA) outlines contaminants regulated by the National Primary Drinking Water Regulations, including fluoride.

4. **Community Water Fluoridation--Public Health Service Recommendation. 2021; Available at: https://www.cdc.gov/fluoridation/faqs/public-service-recommendations.html. Accessed 1/31/2022.**
The U.S. Public Health Services recommended concentration of fluoride in drinking water is 0.7 mg/L "to prevent tooth decay in children and adults while reducing the risks for children to develop dental fluorosis."

5. **Healthy People 2030: Increase the proportion of people whose water systems have the recommended amount of fluoride -- OH-11. 2020; Available at: https://health.gov/healthypeople/objectives-and-data/browse-objectives/health-policy/increase-proportion-people-whose-water-systems-have-recommended-amount-fluoride-oh-11. Accessed 2/3/2022.**
Healthy People 2030 provides background information about tooth decay and fluoride.

6. **Murthy V.H., Collins F.S., D'Souza R. Oral Health in America: Advances and Challenges. National Institutes of Health; December 2021.**
This 2021 follow up to the Surgeon General's 2000 Report on Oral Health in America explores oral health in the U.S. over the last 20 years. It is the result of two years of research and the work of more than 400 contributors.

7. **U.S. Department of Health & Human Services. Oral Health Conditions. 2020; Available at: https://www.cdc.gov/oralhealth/conditions/index.html. Accessed 3 February, 2022.**
This CDC web page provides a high-level overview of oral health conditions including cavities (tooth decay), gum (periodontal) disease, and oral cancer. For example, while "cavities are largely preventable, they are one of the most common chronic diseases throughout the lifespan."

It also notes that "[o]ral conditions are frequently considered separate from other chronic conditions, but these are actually inter-related."

8. **Washington State Board of Health. WAC 246-290-460 Group A Public Water Supplies, Part 5. Water System Operations, Fluoridation of drinking water. 2019.**
WAC 246-290-460 pertains to the fluoridation of drinking water.

9. **Washington State Department of Health, Office of Drinking Water. Fluoride: Is my drinking water fluoridated? Tumwater, WA. 2018.**
The document is a public-facing Question & Answer resource regarding fluoridated water in Washington State.

10. **Washington State Legislature. Chapter 70A.125 RCW--PUBLIC WATER SYSTEMS—PENALTIES AND COMPLIANCE. 2020.**
Chapter 70A.125 RCW outlines requirements for public drinking water systems.

11. **WAC 246-290-100 Group A Public Water Supplies, Part 2. Engineering and Planning Documents, Water system plan.**
WAS 246-290-100 pertains to requirements for water system plans.

12. **State of Iowa General Assembly. House File 390, An act relating to notice requirements prior to discontinuing fluoridation in a public water supply system. 2021.**
Iowa House File 390 requires water systems to notify customers 90 days prior to discontinuing community water fluoridation.

13. **Missouri General Assembly. Chapter 640.136. Fluoridation modification, notification to department and customers. 2016.**
Under Missouri law Chapter 640.136. Fluoridation modification, notification to department and customers, water systems are required to notify customers 90 days prior to a vote to modify community water fluoridation.

14. **State of Tennessee. Code 68-221-708 Notification to public and regulatory agencies. 2021.**
Tennessee Code 68-221-708 requires water systems to notify the public 30 days prior to discontinuing community water fluoridation.

15. **New York State Senate. Public Health Chapter 45, Article 11, Title 1: Section 1100-A Fluoridation. 2015.**
In 2015, New York State passed Public Health Chapter 45, Article 11, Title 1: Section 1100-A Fluoridation. Among other provisions, the law outlines requirements for public notification prior to discontinuing community water fluoridation.

16. **Washington State Department of Health, Office of Drinking Water. Fluoridated Drinking Water, 2018 Washington State Health Assessment. Tumwater, WA. 2018.**
The document provides an overview of fluoridation in Washington State's drinking water.

17. **Washington State Department of Health, Office of Drinking Water. Water System Planning Guidebook. Tumwater, WA. 2020.**
The Guidebook is a resource for developing Water System Plans covering technical, managerial, and financial elements.

18. **Duncan R. Local Government Fiscal Note - HB 1684 Concerning public health and fluoridation of drinking water. Olympia, WA: Washington State Office of Financial Management; 2022.**
Department of Commerce prepared The Local Government Fiscal Note included in the Multiple Agency Fiscal Note for HB 1684, Concerning public health and fluoridation of drinking water. The analysis determined that the legislative impacts for cities and special districts would result in an indeterminate increase in expenditures for municipal water systems and public utilities due to additional work on fluoridation analyses. Specifically, "[t]he amount of additional work would vary between jurisdictions due to the size of jurisdiction, experience in similar kinds of analyses...Therefore, the increase to local government expenditures cannot be determined at this time."

19. **Kliff S. A brief history of America's fluoride wars. *The Washington Post.* May 21, 2013, 2013; Economic Policy.**
The article discussed the controversy surrounding the use of fluoride in community water systems. The article cited a CDC report on fluoridation referendums, reporting that between 1950 and 1967 there were 1,009 fluoridation referendums across the United States. 41% of fluoride proposals were adopted and 59% were rejected. From 1980 to 1988 there were 150 fluoridation votes. 36% of fluoride proposals adopted and 64% were rejected. During the 1990s, of 32 referendums conducted, 59% of fluoride proposals were adopted and 41% were rejected. During the 2000 election cycle, there were 23 fluoridation ballot initiatives. 39% were adopted and 61% were rejected. San Antonio, TX and Clark County, NV passed fluoride referendums during the 2000 election cycle. The percentage of people in the United States receiving fluoridated water by community water systems increased from 62% in 1992 to 69% in 2006.

From: bill teachingsmiles.com
Sent: 9/29/2024 1:44:26 PM
To: Gerald Steel,tips@komonews.com,fox13tips@fox.com,investigations@seattletimes.com,news@spokesman.com,ne

Subject: Re: Federal Court finds 0.7 mg/L fluoridated water poses an "unreasonable risk" to public health [PART 5]

External Email

Gerald,
I read a study where the developmental neurotoxicity effects of fluoride in mice was seen in the third generation where the study ended. Don't ask me for reference. It was at least a decade ago and my memory can't keep track of my cell phone.

Bill

From: Gerald Steel <geraldsteel@yahoo.com>
Sent: Sunday, September 29, 2024 12:54 PM
To: tips@komonews.com <tips@komonews.com>; fox13tips@fox.com <fox13tips@fox.com>; investigations@seattletimes.com <investigations@seattletimes.com>; news@spokesman.com <news@spokesman.com>; newstips@kiro7.com <newstips@kiro7.com>; investigators@king5.com <investigators@king5.com>
Cc: Andy.Schut@doh.wa.gov <andy.schut@doh.wa.gov>; Tao (DOH) <taosheng.kwan-gett@doh.wa.gov>; wsboh@sboh.wa.gov <wsboh@sboh.wa.gov>; secretary@doh.wa.gov <secretary@doh.wa.gov>
Subject: Federal Court finds 0.7 mg/L fluoridated water poses an "unreasonable risk" to public health [PART 5]

The ruling in Food & Water Watch, Inc. v. United States Envtl. Prot. Agency, 17-cv-02162-EMC (N.D. Cal. Sep. 24, 2024) at page 75 discusses the level of IQ loss for new offspring whose mothers when pregnant lived in fluoridated areas [such as Seattle]. Based on data and analysis presented at trial, the Court at page 75 states "fluoride presents a risk of a decrease in IQ [for such offspring] ranging from 2.86 to 6.75 points." The lower number is the expected median loss and the upper number is the 95th percentile loss applicable to offspring of 1 in 20 mothers who drink the most fluoridated water.

My personal comment: It has been on the watch of our Democrat-dominated State government that fluoridation at 0.7 mg/L has been implemented and on the watch of water system administrators that their individual systems are fluoridated. If the 3 point average IQ loss is cumulative over generations, then in 200 years of fluoridation (10 generations) people in fluoridated areas will have lost an average of 30 IQ points. Seattle has been fluoridated for 94 years. Take another look at the movie "Idiocracy." Quoting off the web, in Idiocracy, "Corporal Joe Bauers, a decidedly average American, is selected for a top-secret hibernation program but is forgotten and left to awaken to a future so incredibly moronic that he's easily the most intelligent person alive."

Gerald Steel RCE PE

Retired Attorney
7303 Young Rd. NW

Olympia WA 98502
Tel/Fax (360) 867-1166

From: Julie Simms
Sent: 9/29/2024 3:34:20 PM
To: Gerald Steel
Subject: Re: Federal Court finds 0.7 mg/L fluoridated water poses an "unreasonable risk" to public health [PART 5]

External Email

Thank you, Gerald. This is very exciting.!! Please keep me posted on anyway I can help your efforts.

Sincerely,

Julie Simms

Sent from my iPhone

On Sep 29, 2024, at 12:56 PM, Gerald Steel <geraldsteel@yahoo.com> wrote:

☐

The ruling in Food & Water Watch, Inc. v. United States Envtl. Prot. Agency, 17-cv-02162-EMC (N.D. Cal. Sep. 24, 2024) at page 75 discusses the level of IQ loss for new offspring whose mothers when pregnant lived in fluoridated areas [such as Seattle]. Based on data and analysis presented at trial, the Court at page 75 states "fluoride presents a risk of a decrease in IQ [for such offspring] ranging from 2.86 to 6.75 points." The lower number is the expected median loss and the upper number is the 95th percentile loss applicable to offspring of 1 in 20 mothers who drink the most fluoridated water.

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From: Gerald Steel
Sent: 9/29/2024 1:03:43 PM
To:
tips@komonews.com,fox13tips@fox.com,investigations@seattletimes.com,news@spokesman.com,newstips

Subject: Federal Court finds 0.7 mg/L fluoridated water poses an "unreasonable risk" to public health [PART 5 - CORRECTION]

External Email

CORRECTION: Seattle has been fluoridated for 54 years, not 94 years as previously stated.

Gerald Steel RCE PE
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Tel/Fax (360) 867-1166

On Sunday, September 29, 2024 at 12:54:17 PM PDT, Gerald Steel <geraldsteel@yahoo.com> wrote:

The ruling in Food & Water Watch, Inc. v. United States Envtl. Prot. Agency, 17-cv-02162-EMC (N.D. Cal. Sep. 24, 2024) at page 75 discusses the level of IQ loss for new offspring whose mothers when pregnant lived in fluoridated areas [such as Seattle]. Based on data and analysis presented at trial, the Court at page 75 states "fluoride presents a risk of a decrease in IQ [for such offspring] ranging from 2.86 to 6.75 points." The lower number is the expected median loss and the upper number is the 95th percentile loss applicable to offspring of 1 in 20 mothers who drink the most fluoridated water.

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Gerald Steel RCE PE

Retired Attorney
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Olympia WA 98502
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From: Garry Blankenship
Sent: 8/27/2024 7:38:17 AM
To: hcinfo.infosc@canada.ca,DOH
WSBOH,OADS@cdc.gov,sheriff@co.clallam.wa.us,Berry, Allison 2
(DOHi),shahidafatin@gmail.com,ncarr@cityofpa.us,gbsjrmd@sisna.com,mark.ozias,Randy.Johnson@Clallam

Cc:
Subject: Fwd: US and UK all-cause cumulative excess mortality graphs clearly show that our interventions were counterproductive

External Email

Good Day,

My hope is that any contact on this list please refute the information below. This and similar data are ubiquitous. I can understand making an error, but not acknowledging that error I cannot understand. If this man is wrong, please show me / us.

Regards,

Garry Blankenship

---------- Original Message ----------
From: Steve Kirsch's newsletter <stevekirsch@substack.com>
To: hisgarness@comcast.net
Date: 08/26/2024 10:09 PM PDT
Subject: US and UK all-cause cumulative excess mortality graphs clearly show that our interventions were counterproductive

<https://eotrx.substackcdn.com/open?token=eyJtIjoiPDIwMjQwODI3MDUwOTU4LjMuMTY4M2Q0MDIwYzQ2

Four graphs. Do you think the COVID interventions saved lives? No chance. These charts are monotonically increasing which means everything we did was useless or made things worse!

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for more

US and UK all-cause cumulative excess mortality graphs clearly show that our interventions were counterproductive
<https://gcc02.safelinks.protection.outlook.com/?url=https%3A%2F%2Fsubstack.com%2Fapp-link%2Fpost%3Fpublication_id%3D548354%26post_id%3D148172906%26utm_source%3Dpost-email-title%26utm_campaign%3Demail-post-title%26isFreemail%3Dfalse%26r%3D15ift6%26token%3DeyJ1c2VyX2lkIjo2OTcyNDU1NCwicG9zdF9pZCI6
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Four graphs. Do you think the COVID interventions saved lives? No chance. These charts are monotonically increasing which means everything we did was useless or made things worse!

Steve Kirsch
<https://gcc02.safelinks.protection.outlook.com/?url=https%3A%2F%2Fsubstack.com%2F%40stevekirsch

Aug 27

<https://gcc02.safelinks.protection.outlook.com/?url=https%3A%2F%2Fsubstack.com%2F%40stevekirsch

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reaction%26r%3D15ift6&data=05%7C02%7Cwsboh%40sboh.wa.gov%7Cf4d83edc075748e9acc108dcc6a5

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and-uk-all-cause-cumulative-excess%3Futm_source%3Demail%26redirect%3Dapp-
store&data=05%7C02%7Cwsboh%40sboh.wa.gov%7Cf4d83edc075748e9acc108dcc6a5e0d1%7C11d0e21

Executive summary

Three graphs, pulled from Mortality Watch
<https://gcc02.safelinks.protection.outlook.com/?url=https%3A%2F%2Fsubstack.com%2Fredirect%2Ff7e
18b8-44fd-8739-
61938b09d313%3Fj%3DeyJ1IjoiMTVpZnQ2In0.PoWkYg8wHoPi84O6BbnZ2dl3zAYJI3AKz0ikcuhTjA4&data=
, paints a clear picture of a bungled COVID response that cost lives.

US cumulative excess mortality (ages 10-19)

<https://gcc02.safelinks.protection.outlook.com/?url=https%3A%2F%2Fsubstack.com%2Fredirect%2F820
a229-4a36-b0c1-
dbe4c66b97a6%3Fj%3DeyJ1IjoiMTVpZnQ2In0.PoWkYg8wHoPi84O6BbnZ2dl3zAYJI3AKz0ikcuhTjA4&data=

This is very disturbing. This smacks of pure human intervention because the cumulative mortality rises by nearly the same amount every month. That kind of effect rarely, if ever, happens in nature.

We didn’t save any kids! We KILLED 14,000 kids.

Very few of these were COVID deaths. How do I know? Because COVID deaths come in waves. No waves here.

US cumulative excess mortality (all ages)

<https://gcc02.safelinks.protection.outlook.com/?url=https%3A%2F%2Fsubstack.com%2Fredirect%2Fe7f
583c-4731-8b4d-
e4a7214ab555%3Fj%3DeyJ1IjoiMTVpZnQ2In0.PoWkYg8wHoPi84O6BbnZ2dl3zAYJI3AKz0ikcuhTjA4&data=

You can clearly see that 1.4M lives were lost since the start of the pandemic.

What you can't tell from this is what caused these deaths.

But what you can tell is that it got monotonically worse over time, not better.

The CDC mortality report
<https://gcc02.safelinks.protection.outlook.com/?url=https%3A%2F%2Fsubstack.com%2Fredirect%2F609
79cc-42d6-9f6a-
2beb9aecf57e%3Fj%3DeyJ1IjoiMTVpZnQ2In0.PoWkYg8wHoPi84O6BbnZ2dl3zAYJI3AKz0ikcuhTjA4&data=0
says there were 415,399 deaths caused by COVID in 2021 and an estimated 346,082 in 2020 (from 90% of the value listed in the Table). So a total of 761K deaths from 2020 to 2021. There were 1,024K excess deaths available during this period, so their estimates are within reason. In 2022 there were 246K and in 2023 there were 49K. This totals 1.056M deaths through the end of 2023. It leaves 400K excess deaths unaccounted for.

Based on surveys I've done, the total number of deaths from COVID were comparable to the number of people killed by the COVID shots.

This suggests that the CDC miscategorized deaths and there were probably somewhere around 600K COVID deaths and about 600K vaccine deaths.

Since there were 676M shots given, that's an estimated 1 death per 1,000 COVID shots, a number consistent with the estimates done by others that I've written about in previous articles (Rancourt, Crawford, Skidmore).

The cure was actually more deadly than the disease.

There's a cool paper coming out about this soon. Watch for it. It's conclusion is exactly that.

UK and Massachusetts cumulative excess mortality

Look at these two charts. They look really similar, don't they? But one is from Massachusetts and the other from the UK.

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05c9-471a-b043-
b28774cb8079%3Fj%3DeyJ1IjoiMTVpZnQ2In0.PoWkYg8wHoPi84O6BbnZ2dl3zAYJI3AKz0ikcuhTjA4&data=0

<https://gcc02.safelinks.protection.outlook.com/?url=https%3A%2F%2Fsubstack.com%2Fredirect%2F7ae

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The question you have to ask yourself is how can these graphs look so similar?

Answer: The pandemic responses were very similar and they had similar outcomes, with huge numbers of excess deaths that have gone unexplained. Deaths started to take off after the COVID shots rolled out.

The UK has never explained their excess deaths and I've written how their hypotheses are all flawed
<https://gcc02.safelinks.protection.outlook.com/?url=https%3A%2F%2Fsubstack.com%2Fredirect%2Fbde
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because they don't correlate. They won't consider the possibility that the COVID shots might have played a role even though that is the most obvious explanation.

Summary

This article shows you graphs which are monotonically increasing; this means all our interventions either were useless or made things worse.

My estimate is that the COVID shots killed around 1 person per 1,000 doses. So around 650,000 Americans lost their lives to the shots.

The cure was worse than the disease.

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4MXo99sc2O_M5oxQWiv29eJ_AAAA__9j4XKm>

From: Michael Phillips
Sent: 9/30/2024 5:34:33 PM
To: DOH WSBOH
Cc:
Subject: Cowlitz Public Health

External Email

Hello, I would like to speak to Steven Kutz about the state of public health and the administration of such. I would like to speak to him briefly about the Cowlitz Tribe if possible where he currently is a council member.
Let me know how to get in contact with him if possible, thanks.

*

Michael Phillips

From: Gerald Steel
Sent: 9/29/2024 12:56:02 PM
To:
tips@komonews.com,fox13tips@fox.com,investigations@seattletimes.com,news@spokesman.com,newstips

Subject: Federal Court finds 0.7 mg/L fluoridated water poses an "unreasonable risk" to public health [PART 5]

External Email

The ruling in Food & Water Watch, Inc. v. United States Envtl. Prot. Agency, 17-cv-02162-EMC (N.D. Cal. Sep. 24, 2024) at page 75 discusses the level of IQ loss for new offspring whose mothers when pregnant lived in fluoridated areas [such as Seattle]. Based on data and analysis presented at trial, the Court at page 75 states "fluoride presents a risk of a decrease in IQ [for such offspring] ranging from 2.86 to 6.75 points." The lower number is the expected median loss and the upper number is the 95th percentile loss applicable to offspring of 1 in 20 mothers who drink the most fluoridated water.

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Gerald Steel RCE PE

Retired Attorney
7303 Young Rd. NW

Olympia WA 98502
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From: shellies4@netzero.com
Sent: 9/12/2024 10:45:46 PM
To: DOH WSBOH
Cc:
Subject: Public Comments

External Email

Dear Board,

Regarding the upcoming meeting for school health stuff.
I want to remind the board that PARENTS have the last say when it comes to their children and a SARS COVID shot should NEVER be mandatory for school!
Measles, Mumps, Rubella, YES.
COVID? Absolutely NOT!!
I just want to make sure that this is on record!
I also feel like we should be using bleach for cleaning in a LOT of places and we don't because of some rule somebody decided on? Can we please repeal that??
Also kids get better immune systems from hanging out with other kids! Back to regular lunch in the lunch room with everyone! The lack of socializing is worse than the risk of getting a cold!! We already have FAR too many kids who feel isolated!
Bleach for cleaning up and vitamin D from sunshine goes a LONG way!
Thank you for all you do!
Have a wonderful day!

From: Arne Christensen
Sent: 8/12/2024 2:35:23 PM
To: DOH WSBOH
Cc:
Subject: a police state is a paradise

External Email

Recently I read a 2015 book, The Real North Korea, by Andrei Lankov. There's a quote in it from a Western doctor: "For a health care professional, a police state is a paradise."

The Board of Health should reflect on that quote, and consider whether it has ever thought of the ethical and moral problems with forcing people to receive medical treatments.

From: bill teachingsmiles.com
Sent: 9/25/2024 3:41:20 PM
To: DOH WSBOH,Leaders, Amber (GOV),serviceATG@atg.wa.gov
Cc:
Subject: Public Comment, US District Court

attachments\A3E5632AD1DB4ABF_Court Ruling.pdf

External Email

Washington State Board and Department of Health, Governor Inslee,
amber.leaders@gov.wa.gov <mailto:amber.leaders@gov.wa.gov> Attorney General Ferguson, serviceATG@atg.wa.gov <mailto:serviceATG@atg.wa.gov>
Public Comment For October 8, 2024 Board of Health meeting and requesting time for Public Comment and notification to Governor Inslee and Attorney General Ferguson, and request to provide comment at the BOH meeting, October 8.

Dear Washington State Authorities,
When I, along with others, nominated fluoride to the National Toxicology Program for their review of fluoride's carcinogenicity, thyroid harm and a third for developmental neurotoxicity back in 2015, the director told me it would take about 2 years to just evaluate developmental neurotoxicity. The first part of the report was published almost 9 years later due to political resistance and did not report a lower threshold or safe exposure level of fluoride.
We took the EPA to court over just one health risk, not all the health, legal or ethical risks, just one risk, developmental neurotoxicity.
The Court ruled September 24, 2024, after the second phase of the trial, eight years and hundreds of thousands of dollars in legal fees paid for by those who have been harmed:
"CONCLUSIONS OF LAW Plaintiffs have proven, by a preponderance of the evidence, that water fluoridation at the level of 0.7 mg/L – the prescribed optimal level of fluoridation in the United States – presents an "unreasonable risk of injury to health or the environment, without consideration of costs or other non-risk factors, including an unreasonable risk to a potentially exposed or susceptible subpopulation under the conditions of use."
I always wonder what would the Court have ruled if we had listed all risks of harm and ethics, not just one risk of harm. The trial would have lasted for several months, not just weeks.
Of course, the Washington State Board, Department of Health, and Governor have known fluoridation is an unreasonable risk for over a decade with thousands of documents in their possession petitions for rule changes and resulting denials. The Board, Department, and Governor have failed to protect the public health and thousands have been unnecessarily harmed by the Board's failure to evaluate the science rather than endorsements.
The Board and Department ignored the Washington State Board of Pharmacy determining fluoride is a legend drug, requiring the patient's doctor's prescription and each patient's consent.
The Board, Department, and Governor ignored the FDA (Food and Drug Administration) warning that attempting to gain FDA approval would ban fluoridation. Fluoride ingestion is not an approved drug and could not be approved as recommended by the Board; however, the Board failed to mitigate the harm with even simple rule changes of warnings and should have stopped recommending fluoridation. Instead, the Board went to a dentist with vested interest who copied the fluoridation lobby talking points to write an opinion. Similar to asking the tobacco lobby to write a statement on the safety of tobacco.
The Board and Department ignored the National Research Council 2006 warning that fluoride ingestion was not safe for teeth, bones, brain, thyroid, and more. At least 70%

of us are ingesting too much fluoride from many sources.
The Board ignored my repeated requests to simply advise pregnant mothers to not swallow fluoride (same warning on toothpaste) and caregivers to not make infant formula made with fluoridated water. (Fluoridated water doses infants with over 150 times more fluoride than mother's milk.)
The Board has ignored the NTP (National Toxicology Program) report on fluoride's harm.
The Board must not ignore the Court's Finding of Fact and Conclusions of Law Case No. 17-cv-02162-EMC, US District Court, Northern District of California see attached.
The Board and Department stubbornly try to remain unmolested by enlightenment of science, fact, empirical evidence, law and ethics.
If the highest levels of regulatory authorities cannot persuade the Board, Department, and Governor to protect our most vulnerable and yes, all of us, then the Board, Department and Governor cannot and must not be trusted without verification for any scientific health care policy or opinion. The Board has clearly demonstrated they are not capable of evaluating science.
We all make mistakes, covering up the mistake can be worse than the mistake.
Government's job is to protect the pubic health, not mistakenly attempt to mitigate one of the public's excess sugar consumption harms and line the pockets of special interests.
The attached Court "Finding of Fact and Conclusion of Law" is 800 pages and should be read in entirety because it has excellent science and law, keeping in mind this is only one stream of evidence. Compound the conclusion with:

1.

Lack of consent, lack of freedom, dispensed under police powers when options are less expensive and available.
2. Over exposure from many sources, such as 70% of children show a biomarker of excess exposure.
3. Lack of cost benefit if risks and cost of treating harm is included. As a Dentist, when I now look back, I made millions of dollars in my career, selling fluoride and treating both known and undisputed cosmetic and known and undisputed functional dental fluorosis (chipped, cracked and split teeth contributed by fluoride. Fluoridation is not cost effective. Dentists may not point the economic finger of bias at themselves, but fluoride is major profit for dentists.
4. Known carcinogen. Ever wonder how pharmaceutical companies get hundreds of mice with the same cancer to test new pharmaceutical treatments? Sometimes they use fluoride to cause the cancer so they can try to treat it. Do a www.pubmed.gov <https://gcc02.safelinks.protection.outlook.com/?url=http%3A%2F%2Fwww.pubmed.gov%2F&data=05%
search for "fluoride known carcinogen." I get 84 results. Read a few.
5.

Thyroid harm. Back in the early mid 20th Century, fluoride was used as a treatment for ADHD. Doctors recommended, "If it does not work, raise the dosage." Look at the chemical formulas today for ADHD medications, they contain fluoride.
6. Mitochondria. Again, Pubmed search of "fluoride mitochondria" results in 479 studies. (Definitions might help here: Apoptosis means cell death. Dysfunction means cell does not work well. Cognitive deficits means it harms thinking. Oxidative stress is cell damage. Intracellular redox homeostasis or a balance between reducing and oxidizing reactions in cells involved with many biological responses and events.) At least read a few studies. That is your job.

Those are just a few to consider, any one of them should stop forced medication of an unapproved contaminated and illegal drug.
A few more considerations in the Courts Decision.
Page 5. "The pooled benchmark dose analysis concluded that a 1-point drop in IQ of a child is to be expected for each 0.28 mg/L of fluoride in a pregnant mother's urine. This is highly concerning, because maternal urinary fluoride levels for pregnant mothers in the United States range from 0.8 mg/L at the median and 1.89 mg/L depending upon the

degree of exposure. Not only is there an insufficient margin between the hazard level and these exposure levels, for many, the exposure levels exceed the hazard level of 0.28 mg/L."

Highlight supplied but not bolded emphasis done by the Court. Note: mother's urine concentration is often close to water fluoride concentration. For example, 0.8 mg/L mother's urine at the median is similar to 0.7 mg/L in fluoridated water. 0.8 mg/L divided by 0.28 mg/L equals about 3 IQ loss for the mean and about 6 IQ loss for the 90th percentile which is consistent with published literature. That equals about a 30% to 70% increase in the number of mentally retarded and 30% to 70% decrease in the number of gifted residents and a drop for all the rest of us in IQ.

P6. "The EPA's default margin of error requires a factor of 10 between the hazard level and exposure level due to variability in human sensitivities. Put differently, only an exposure that is below 1/10th of the hazard level would be deemed safe under Amended TSCA, given the margin of error required."

Instead of a 1/10, the EPA uses a 1:1 margin of error for fluoride, incorrectly assuming there is no variability in human health, age, total toxic burden, synergistic effects, DNA, etc. Thus 0.28 mg/L of fluoride in mother's urine must be divided by 10 for a concentration 0.028 mg/L and 100 is recommended for safety if LOAEL (Least Observable Adverse Effect Level) is used, thus 0.0028 mg/L very similar to the concentration of fluoride in mother's milk should be safe even for infants.

P 6. "In all, there is substantial and scientifically credible evidence establishing that fluoride poses a risk to human health; it is associated with a reduction in the IQ of children and is hazardous at dosages that are far too close to fluoride levels in the drinking water of the United States. And this risk is unreasonable under Amended TSCA. Reduced IQ poses serious harm. Studies have linked IQ decrements of even one or two points to e.g., reduced educational attainment, employment status, productivity, and earned wages. Indeed, the EPA recognizes that reduction of IQ poses a serious community health issue."

Lower IQ is well-know, to result in increased Special Education rates, High School Drop-out rates, lower income, less job stability, less productivity, increased crime, increased homelessness, increased incarceration, increased divorce, decreased self-worth, increased public assistance and decrease gifted and brilliant members of our community and actually all of us.

Those harms, costs, grief and suffering are in part on the shoulders of the Board, Department of Health, and Governor, having known those harms for more than a decade. And authorities have refused to protect the public even with simple advice or more cautious words.

The Board is now trying to play a Trumpian spin, "just words." The Board claims they do not fluoridate water, they just use words to encourage the use of fluoridation. But words by authorities have impact and place responsibility. The Board has responsibility for their words and has refused a forum to even evaluate the evidence from both sides as RCW requires. Don't try to hide and blame the local cities and water districts for doing harm when they are following words of advice of the Washington State Authority.

Further, specifically to the Attorney General:

Although historic, consider HEALTH DEPARTMENT REGULATIONS -- FLUORIDATION OF WATER | Washington State
<https://gcc02.safelinks.protection.outlook.com/?url=https%3A%2F%2Fwww.atg.wa.gov%2Fago-opinions%2Fhealth-department-regulations-fluoridation-water&data=05%7C02%7CWSBOH%40SBOH.WA.GOV%7Cd81159897eec473de4c108dcddb328e5%7C11d

Smith Troy, AG wrote:

"The general rule is that incorporated boards of health which are invested by statute with functions of a public nature, to be exercised for the public benefit, are not liable for injuries resulting from the performance of their official duties in the promulgation and enforcement of health regulations, so long as they act within the limits of their authority and discretion,"

First: the Board has acted on the authority of the fluoridation lobby, financially vested interest and industry (biased entities) which is outside the official duties of the Board, rather than the authority of duly designated Federal and State drug regulatory authorities and Federal toxicological and state pharmaceutical experts which is within the duty of the Board.

Seriously, the local dentist down the street does not have the authority of the FDA, NTP or Board of Pharmacy.

Second: the Board has violated RCW 43.20.050 duty which requires the Board to provide a forum. A 2- or 3-minute public comment is not a forum.

Third: RCW 43.20.050 requires the Board to adopt rules to assure safe and reliable public drinking water and the Court clear finding of fact does not agree with the Board's claim of fluoridation's safety. The WBOP, FDA, NRC 2006, EPA DRA 2010 and scientists, NTP, Court and thousands of peer reviewed scientific studies do not agree with the Board that fluoridated water is safe. Yet the Board keeps claiming fluoridation is safe based on lobby propaganda.

About 20 petitions for rule change to protect the fetus and infant from excess exposure with simple advice, over about the last decade have all been denied. Thus, we went to the NTP and US District Court for confirmation of our claim that fluoridation is harming millions.

My request to you as AG, is to evaluate the attached Court finding of Fact and Conclusion and encourage in the strongest language the Board and Department of Health must protect the public health. You do not want this can of worms to hit you in the face next year.

Sincerely yours,

Bill Osmunson DDS MPH
bill@teachingsmiles.com

UNITED STATES DISTRICT COURT

NORTHERN DISTRICT OF CALIFORNIA

FOOD & WATER WATCH, INC., et al.,

Plaintiffs,

v.

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY, et al.,

Defendants.

Case No. 17-cv-02162-EMC

FINDINGS OF FACT AND CONCLUSIONS OF LAW

I. INTRODUCTION

In 2016, Congress amended the Toxic Substances Control Act ("TSCA"), empowering United States citizens to petition the Environmental Protection Agency ("EPA") to consider whether a chemical presents an unreasonable risk of injury to health. *See* Pub. L. No. 114-182, 114th Congress (Frank R. Lautenberg Chemical Safety for the 21st Century Act) (the "Act"). The Act addresses the modern day reality that "human beings and the environment are being exposed each year to a large number of chemical substances and mixtures," 15 U.S.C. § 2601(a)(1), and that, "among the many chemical substances and mixtures which are constantly being developed and produced, there are some whose manufacture, processing, distribution in commerce, use, or disposal may present an unreasonable risk of injury to health or the environment," *id.* § 2601(a)(2).

To this end, under TSCA, as amended by the Act ("Amended TSCA"), a citizen is entitled to judicial review of the EPA's denial of the citizen's petition, wherein a court considers whether the chemical poses an unreasonable risk *de novo*, *i.e.*, without deference to the EPA's decision. *See id.* § 2620(b)(4)(B). Amended TSCA sets up a system of judicial review that is remarkably different from the usual scope of judicial review of administrative actions under the Administrative Procedure Act, which confers substantial deference to administrative agencies. *See id.* Under Amended TSCA, the Court owes no deference to the EPA in assessing the risk posed by chemical substances. *See id.* If the Court finds anew that the chemical at issue presents an unreasonable risk, it then orders the EPA to engage in rulemaking regarding the chemical. *See id.* The EPA is afforded in the first instance the authority to respond; regulatory actions can range from requiring a mere warning label to banning the chemical. *See id.* § 2605(a)(1)-(7). The EPA, in short, has options. *See id.*

The issue before this Court is whether the Plaintiffs have established by a preponderance of the evidence that the fluoridation of drinking water at levels typical in the United States poses an unreasonable risk of injury to health of the public within the meaning of Amended TSCA. For the reasons set forth below, the Court so finds. Specifically, the Court finds that fluoridation of water at 0.7 milligrams per liter ("mg/L") – the level presently considered "optimal" in the United States – poses an unreasonable risk of reduced IQ in children. It should be noted that this finding does not conclude with certainty that fluoridated water is injurious to public health; rather, as required by the Amended TSCA, the Court finds there is an unreasonable *risk* of such injury, a risk sufficient to require the EPA to engage with a regulatory response. This order does not dictate precisely what that response must be. Amended TSCA leaves that decision in the first instance to the EPA. One thing the EPA cannot do, however, in the face of this Court's finding, is to ignore that risk.

A. <u>Context</u>

Water fluoridation has a long history in the United States and has been a source of political discord, at times. *See, e.g.*, Dkt. No. 429-3, Trial Ex. 13 at 15.[1] In 1975 the EPA recommended adding fluoride to water, with an optimal level up to 1.2 mg/L for its dental health benefits. *Id.* at 16. Between 1981 and 1984, fluoride's association with adverse effects including osteosclerosis, enamel fluorosis, and psychological and behavioral problems was contested. *Id.* at 17-18. Still, as of 1986, up to 1.2 mg/L water fluoridation was considered optimal, and the maximum level was 4 mg/L. *Id.* at 14-18. After evidence increasingly established fluoride's connection to adverse

[1] Controversy over fluoridation of drinking water has even found its way into Hollywood. *See* DR. STRANGELOVE (Columbia Pictures 1964) (General Ripper characterizing fluoridation as a threat to our "precious bodily fluids" and "the most monstrously conceived and dangerous communist plot we've ever had to face").

effects, including severe enamel fluorosis, risk of bone fracture, and potential skeletal fluorosis, recommended levels were lowered in 2006. *Id.* at 10. Community water fluoridation has since continued at levels believed to be safe for its dental health benefits. At present, fluoride is added to tap water in the United States, with an optimal level of 0.7 mg/L.

However, scientific evidence has increasingly identified a link between fluoride exposure and adverse cognitive effects in children (reduced IQ). Accordingly, Plaintiffs exercised their power under Amended TSCA and petitioned the EPA to consider whether fluoride in drinking water presents an unreasonable risk of injury to human health. Notwithstanding the growing and robust body of evidence indicating an association between fluoride intake and cognitive impairment in children, the EPA denied Plaintiffs' petition. Plaintiffs filed suit in this Court, arguing that the EPA was wrong and that community water fluoridation at 0.7 mg/L (the "condition of use") poses an unreasonable risk of injury to human health.

B. Summary

To succeed in a suit brought under the Amended TSCA, Plaintiffs must prove, by a preponderance of the evidence, that a risk of injury to human health is present and that such risk is unreasonable. For a risk to be present, Plaintiffs must show that some segment of the United States population is exposed to the chemical at issue at levels that either exceed, or are too close to the dosage at which the chemical presents a hazard.[2] The reasonableness of the risk is informed by several factors, including *inter alia*, the size and susceptibility of impacted populations, severity of the harm at issue, and the frequency and duration of exposure.

There is little dispute in this suit as to whether fluoride poses a hazard to human health. Indeed, EPA's *own expert* agrees that fluoride is hazardous at some level of exposure. And ample evidence establishes that a mother's exposure to fluoride during pregnancy is associated with IQ decrements in her offspring. The United States National Toxicology Program ("NTP") – the federal agency regarded as experts in toxicity – undertook a systematic review of all available literature near the time of publication considering whether fluoride poses cognitive harm,

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[2] The level at which the chemical presents a hazard is known as the "hazard level." The level at which human populations are exposed to the chemical is known as the "exposure level."

reviewing 72 human epidemiological studies considering this question. The NTP concluded that fluoride is indeed associated with reduced IQ in children, at least at exposure levels at or above 1.5 mg/L (*i.e.*, "higher" exposure levels). And notwithstanding inherent difficulties in observing effects at lower exposure levels, explained in further detail below, scientists have observed a statistically significant association between fluoride and adverse effects in children even at such "lower" exposure levels (less than 1.5 mg/L).

Notwithstanding recognition by EPA's expert that fluoride is hazardous, the EPA points to technicalities at various steps of the risk evaluation to conclude that fluoride does not present an unreasonable risk. Primarily, the EPA argues the hazard level and the precise relationship between dosage and response at lower exposure levels are not entirely clear. These arguments are not persuasive.

Importantly, the chemical at issue need not be found hazardous at the exposure level to establish that a risk is present under Amended TSCA. Instead, the EPA requires a *margin* exist between the hazard level and exposure level to ensure safety; if there is an insufficient margin then the chemical poses a risk. The trial evidence in this case establishes that even if there is some uncertainty as to the precise level at which fluoride becomes hazardous (hazard level), under even the most conservative estimates of this level, there is not enough of a margin between the accepted hazard level and the actual human exposure levels to find that fluoride is safe. Simply put, the risk to health at exposure levels in United States drinking water is sufficiently high to trigger regulatory response by the EPA under Amended TSCA.

To this end, as mentioned previously, the NTP compiled and analyzed all relevant studies it could find and concluded that, at least at dosages of 1.5 mg/L or higher, fluoride is associated with reduced IQ in children. Subsequently, toxicology experts endeavored to put a finer point on the impact of fluoride on children's IQ at "lower" exposure levels, *i.e.*, those below 1.5 mg/L, and conducted a pooled benchmark dose analysis to define the precise hazard level of fluoride. For reasons described below, this pooled benchmark dose analysis benefited from increased statistical power relative to the NTP's assessment due to its methodology (*i.e.*, the benchmark dose analysis used individualized, continuous data, while the NTP assessment did not, due to quantity and variety of studies the NTP reviewed in that assessment). The pooled benchmark dose analysis concluded that **a 1-point drop in IQ of a child is to be expected for each 0.28 mg/L of fluoride in a pregnant mother's urine**. This is highly concerning, because maternal urinary fluoride levels for pregnant mothers in the United States range from **0.8 mg/L** at the median and **1.89 mg/L** depending upon the degree of exposure. Not only is there an insufficient *margin* between the hazard level and these exposure levels, for many, the exposure levels *exceed* the hazard level of 0.28 mg/L.

The EPA challenges, for a variety of reasons, whether this 0.28 mg/L hazard level (measured in maternal urinary fluoride) is appropriate for this risk evaluation. The EPA argues, among other things, that the hazard and exposure levels should not be expressed in maternal urinary fluoride because that metric reflects total fluoride exposure – not just exposure resulting from drinking fluoridated water from one's community. Fluoride may also be ingested through, *e.g.*, tea, fish, toothpaste, and commercial food and beverage made with fluoridated water. Nonetheless, the risk analysis should consider the *additive* effect of the chemical under the subjected condition of use (here, fluoridated community drinking water), especially where, as here, the fluoridated drinking water is a significant (and likely primary) contributor to aggregate exposure to fluoride. Indeed, the Amended TSCA, expressly contemplates that the *aggregate* exposure to a chemical will be considered when conducting a risk assessment. *See* 15 U.S.C. § 2605(b)(4)(F). In this sense, maternal urinary fluoride is not just an acceptable metric, it is highly useful in assessing the real-world end result of exposure from drinking fluoridated water along with other sources.

Even if urinary fluoride were not the appropriate metric in assessing health risk, or even if the toxicologically determined hazard level of 0.28 mg/L were deemed insufficiently substantiated, evidence in the record still establishes with little doubt that fluoridated drinking water presents a risk of injury to health. Using a highly conservative estimate of the hazard level of 4 mg/L measured in drinking water fluoride (well above the 1.5 mg/L identified as hazardous to children by the NTP) based on the consistent and repeated observation of adverse effects summarized in the NTP's assessment, a risk is present. There is little dispute that there is a statistically significant association between IQ decrements in children and fluoride concentration levels at 4 mg/L.

The EPA's default margin of error requires a factor of 10 between the hazard level and exposure level due to variability in human sensitivities. Put differently, only an exposure that is below 1/10th of the hazard level would be deemed safe under Amended TSCA, given the margin of error required. Here, an even greater margin (100x) is owed because the methodology (which yields the 4 mg/L hazard level) uses the lowest observed adverse effect level ("LOAEL"); this methodology adds an additional level of uncertainty (and hence the application of a 100x rather than 10x margin). But even if only the default 10x margin is required, the safe level of fluoride exposure would be 0.4 mg/L (4 mg/L (hazard level) divided by 10). The "optimal" water fluoridation level in the United States of 0.7 mg/L is nearly double that safe level of 0.4 mg/L for pregnant women and their offspring.

In all, there is substantial and scientifically credible evidence establishing that fluoride poses a risk to human health; it is associated with a reduction in the IQ of children and is hazardous at dosages that are far too close to fluoride levels in the drinking water of the United States. And this risk is unreasonable under Amended TSCA. Reduced IQ poses serious harm. Studies have linked IQ decrements of even one or two points to *e.g.*, reduced educational attainment, employment status, productivity, and earned wages. Indeed, the EPA recognizes that reduction of IQ poses a serious community health issue. Moreover, highly susceptible populations are impacted, including over two million pregnant women and babies, a number far exceeding population size the EPA has looked to in determining whether regulatory action was warranted in other risk evaluations (*i.e.*, 500 people or less).

Thus, the Court finds Plaintiffs have met their burden in establishing, by a preponderance of the evidence, that community water fluoridation at 0.7 mg/L presents an unreasonable risk of injury to health under Amended TSCA and that the EPA is thus obliged to take regulatory action in response. The Court does not in this order prescribe what that response should be.

II. BACKGROUND

A. Factual and Procedural Background

1. Section 6(a) of the Toxic Substances Control Act ("TCSA") requires Defendant United States EPA[3] to regulate the use of certain chemical substances that it determines pose an unreasonable risk to health or the environment. 15 U.S.C. § 2605(a).

2. The TSCA was initially passed in 1976, codified at 15. U.S.C. § 2601 *et seq.* Congress enacted the original TSCA, motivated by findings that "human beings and the environment are being exposed each year to a large number of chemical substances and mixtures," 15 U.S.C. § 2601(a)(1), and that, "among the many chemical substances and mixtures which are constantly being developed and produced, there are some whose manufacture, processing, distribution in commerce, use, or disposal may present an unreasonable risk of injury to health or the environment," *id.* § 2601(a)(2).

3. On June 22, 2016, the Frank R. Lautenberg Chemical Safety for the 21st Century Act was signed into law. *See* Pub. L. No. 114-182, 114th Congress. The Act amended the TSCA. *See id.*

4. Amended TSCA requires the EPA to regulate the use of certain chemical substances that pose an unreasonable risk of harm to health or the environment. 15 U.S.C. § 2605(a). If a chemical substance poses a risk of unreasonable harm, the EPA must promulgate a rule imposing one or more of a wide range of possible requirements. *See id.* § 2605(a)(2). Specifically, the rule adopted by the EPA must impose one or more of the following: a prohibition, restriction, or limitation of the amount of such substance that may be manufactured, processed, or distributed in commerce, *id.* § 2605(a)(1); a prohibition, restriction, or limitation upon such manufacture, processing, or use in connection with "a particular use" or "a particular use in a concentration in excess of a level specified by the Administrator," *id.* § 2605(a)(2); labeling requirements for such substance, *id.* § 2605(a)(3); record-keeping requirements for manufacturers or processors of the substance, *id.* § 2605(a)(4); commercial-use regulations, *id.* § 2605(a)(5); disposal requirements,

[3] Scott Pruitt, Administrator of the EPA is also named as a Defendant in his official capacity. Dkt. No. 372 (Supplemental Complaint ("FAC")) ¶ 1.

id. § 2605(a)(6); and/or notice requirements, *id.* § 2605(a)(7). The EPA may limit the application of such requirements to "specified geographic areas." *Id.* § 2605(a).

5. After the Act's amendment to TSCA, there are three pathways to obtain a Section 6(a) rule regulating a chemical: (1) an EPA's *sua sponte* designation of a chemical as "high priority," resulting in a finding that it presents an unreasonable risk,[4] 15 U.S.C. § 2605(c)(1); (2) an EPA risk evaluation of a chemical at the request of a manufacturer, *see id.* § 2605(b)(4)(C)(ii), which results in a finding of unreasonable risk; or (3) a successful Section 21 "citizen petition," *see id.* §§ 2620(a), (b)(3).

6. A Section 21 citizen's petition to the EPA to initiate Section 6(a) rulemaking is to be granted if the petitioner demonstrates a chemical substance poses an unreasonable risk of harm. *Id.* § 2620(a). Amended TSCA provides judicial review of a denial of such a petition to the EPA. *Id.* § 2620(b)(4). In contrast to the typical standard of judicial review under the Administrative Procedure Act, in considering a Section 21 citizen's petition, the Court considers the issue *de novo*; no deference is owed under to the EPA's denial of the petition. *See id.* § 2620(b)(4)(B).

7. Plaintiffs in the instant suit are non-profit advocacy organizations and associations and individuals suing on behalf of themselves and their children. FAC ¶ 1.[5]

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[4] To elaborate, Section 6(b) requires the EPA to perform its own evaluations of the risks posed by certain chemical substances. 15 U.S.C. § 2605(b)(4)(A). To this end, the EPA is required by Amended TSCA to designate chemical substances as "high-priority" or "low-priority" based on a risk screening process. *See id.* § 2605(b)(1). "High-priority" chemicals are those that "may present an unreasonable risk to health or the environment because of potential hazard and a potential route of exposure under the conditions of use." *Id.* § 2605(b)(1)(B)(i). A "low-priority" substance, in contrast, is one that the Administrator "concludes, based on information sufficient to establish . . . does not meet the standard" to be designated a high-priority substance. *Id.* § 2605(b)(1)(B)(ii). Once the EPA has designated a chemical substance "high-priority," it must initiate a Section 6(b) "risk evaluation." *Id.* §§ 2605(b)(3)(A), (4)(C)(i). A risk evaluation is not required for a "low-priority" substance. *Id.* § 2605(b)(1)(A). The EPA must pursue these risk evaluations at a minimum pace established by statute: within 6 months, risk evaluations must be underway on at least 10 substances drawn from the 2014 TSCA Work Plan for Chemical Assessments, *id.* § 2605(b)(2)(A); within three and a half years, risk evaluations must be underway on "at least 20 high-priority substances," *id.* § 2605(b)(2)(B); a new high-priority substance must be designated anytime a risk evaluation has been completed (other than those commenced at the request of a manufacturer), *id.* § 2605(b)(3)(C); and, generally, the EPA must continue designating substances and conducting evaluations "at a pace consistent" with its ability to meet the 3-year deadline to complete each risk evaluation, *id.* § 2605(b)(2)(C).

[5] Specifically, Plaintiffs are Food & Water Watch, Fluoride Action Network, and Moms Against Fluoridation ("Organizational Plaintiffs"), and Audrey Adams individually and on behalf of Kyle

United States District Court
Northern District of California

8. On November 22, 2016, a group of organizations and individuals including Plaintiffs petitioned the EPA under Section 21 of Amended TSCA to regulate the fluoridation of drinking water supplies under Section 6(a). Dkt. No. 117-1, Ex. 1. Plaintiffs asserted that the ingestion of fluoride poses an unreasonable risk of neurotoxic harm to humans including IQ loss and other neurotoxic effects, particularly for infants, young children, and other subpopulations standing at elevated risk. *Id.*

9. On February 17, 2017, the EPA denied Plaintiffs' petition. Dkt. No. 28-1; 82 Fed. Reg. 11,878 (Feb. 27, 2017).

10. After the EPA denied Plaintiffs' petition, Plaintiffs filed this suit seeking judicial review of the EPA's denial pursuant to 15 U.S.C. § 2620. Dkt. No. 1 (Complaint ("Compl.")) ¶¶ 106-07.

11. Beginning on June 8, 2020, after the parties engaged in fact and expert discovery, the Court held a seven-day bench trial, which included expert testimony regarding the state of the scientific research on fluoride neurotoxicity ("Trial Phase 1"). *See* Dkt. Nos. 219, 238.

12. On August 10, 2020, the Court stayed the case due to concerns about Plaintiffs' standing and developments in scientific literature regarding fluoride. *See* Dkt. No. 262. The Court explained that the stay would allow EPA to consider new scientific studies published after EPA's denial of Plaintiffs' administrative petition and allow the Court to consider the imminent publication of the NTP systematic review "Monograph on the Systematic Review of Fluoride Exposure and Neurodevelopmental and Cognitive Health Effects." *Id.* at 3-5.

13. Thereafter, Plaintiffs filed a supplemental administrative petition for reconsideration to the EPA. Dkt. No. 270.

14. EPA again denied the petition. Dkt. No. 278.

15. On October 28, 2022, the Court granted Plaintiffs' motion to lift the stay and take the case out of abeyance, finding that Plaintiffs had standing and that there was new evidence that scientific developments had changed, including the fact that the aforementioned NTP's systematic review

Adams, Kristen Lavelle individually and on behalf of Neal Lavell, and Brenda Staudenmaier individually and on behalf of Ko Staudenmaier and Hayden Staudenmaier ("Individual Plaintiffs") (collectively "Plaintiffs" or "FWW"). FAC ¶ 1.

had since undergone three additional rounds of peer review resulting in a near-final version of the document. *See* Dkt. No. 319 at 2-5.

16. Beginning on January 31, 2024, the Court held a second, ten-day bench trial ("Trial Phase 2") which included expert testimony regarding the updated state of the scientific research on fluoride neurotoxicity. *See* Dkt. Nos. 407-413, 422-424.

B. <u>Relief Requested</u>

17. Plaintiffs contend that the addition of fluoridation chemicals to drinking water at levels recommended in the United States (0.7 mg/L) presents an unreasonable risk of neurological harm when assessed under the risk evaluation framework that EPA uses under the Amended TSCA. Dkt. No. 378 (Joint Pretrial Conference Statement ("PTC Statement")) at 1-2.

18. Plaintiffs seek a declaration that fluoridation of water at 0.7 mg/L presents an unreasonable risk of injury to health and injunctive relief requiring the EPA to initiate the rulemaking proceeding requested by Plaintiffs in their Petition to the EPA. PTC Statement at 2. Specifically, Plaintiffs seek an order requiring the EPA to "initiate a proceeding for the issuance of a rule," but the order would not "prescribe the content of a rule or the outcome of such a proceeding." *Id.* In short, rulemaking would be left in the first instance to the EPA.

19. Plaintiffs also seek recovery of their costs of suit and reasonable fees for attorneys and expert witnesses, as permitted by 15 U.S.C. § 2620(b)(4)(C), and such further relief that the Court may deem just and proper. PTC Statement at 2.

C. <u>Statutory Standard and Burden</u>

20. Plaintiffs bear the burden of proving, by a preponderance of the evidence, that the chemical substance at issue presents an "unreasonable risk of injury to health or the environment, without consideration of costs or other nonrisk factors, including an unreasonable risk to a potentially exposed or susceptible subpopulation under the conditions of use." 15 U.S.C. § 2620(b)(4)(B)(ii). The Court considers the issue *de novo*; no deference is owed under TSCA to the EPA's denial of the petition. *Id.* § 2620(b)(4)(B).

21. If the Court determines that petitioner has met its burden, demonstrating unreasonable risk by a preponderance of the evidence, the Court "shall order the Administrator to initiate the action

requested by the petitioner." *Id.* Specifically, EPA would be directed to engage in rulemaking pursuant to Subsection 6(a) of TSCA wherein the EPA would consider applying one or more methods to neutralize the risk, ranging from requiring a notice be provided to the public of risks (*i.e.*, utilizing a warning label or disseminating a public advisory), *see id.* § 2605(a)(7), to prohibiting manufacturing or distributing the chemical at issue, *see id.* § 2605(a)(1).

D. Standing

22. The Court previously held, in lifting its stay on proceedings and allowing the case to proceed to phase two of trial, that Plaintiffs had standing. Dkt. No. 319 at 2-3. The Court reaffirms this finding. At a minimum, Organizational Plaintiff FWW has standing in a representative capacity. An association has standing to sue on behalf of its members when: "(1) its members would otherwise have standing to sue in their own right; (2) the interests it seeks to protect are germane to the organization's purpose; and (3) neither the claim asserted nor the relief requested requires the participation of individual members in the lawsuit." *Am. Unites for Kids v. Rousseau*, 985 F.3d 1075, 1096 (9th Cir. 2021) (citing *Hunt v. Wash. State Apple Advert. Comm'n*, 432 U.S. 333, 343 (1977)). Each prong is satisfied:

a. In its previous order, the Court found that Jessica Trader, a member of FWW, has standing. Dkt. No. 319 at 2-3. Article III standing requires: (1) an injury-in-fact that is concrete and particularized and actual or imminent, (2) a causal connection between the injury and the conduct complained of, and (3) probable redressability. *Id.* (citing *Lujan v. Defs. of Wildlife*, 504 U.S. 555, 560–61 (1992)). Ms. Trader became pregnant in November 2020 and gave birth in August 2021 (during the pendency of this lawsuit) and testifies that she plans to have several more children; she has taken steps to effectuate this goal including discontinuing her use of birth control medication. Dkt. No. 430-18, Trial Ex. 66 (Declaration of Jessica Trader) ¶¶ 5-8 & Ex. A. Ms. Trader has incurred costs and taken measures to avoid fluoridated water during her first pregnancy and continues to do so to protect her future children. *Id.* ¶¶ 9-16. As the Court previously explained, neurodevelopmental harm from fluoride exposure to Ms. Trader's child and future children is concrete and imminent; there is a credible causal connection between that neurodevelopmental harm and EPA's regulation of fluoride exposure or lack thereof; and the harm would likely be redressed if EPA were to pass a rule prohibiting the addition of fluoridation chemicals to public drinking water supplies. Dkt. No. 319 at 2-3. Moreover, the EPA has conceded that standing would be satisfied by "someone who is an expectant parent who – who could be consuming fluoridated water, and, and – that could have potential effects on the baby she's carrying in utero. It could be a potential – a parent, someone with very young children." *Id.* (quoting Dkt. No. 133 at 14:9-17). Ms. Trader is such an individual. Thus, the first prong is satisfied; a member has standing.

b. As for the second prong, there is no dispute that FWW's mission is to ensure "clean, safe water for drinking" which it views as a "fundamental right that should be afforded to all people," and to "advocate for more government responsibility in protecting our drinking water resources." Dkt. No. 430-8, Trial Ex. 52 (Second Amended Declaration of Scott Edwards, Co-Director of FWW) ¶¶ 4, 6. Thus, the interests at stake in this suit – regulation of water fluoridation to protect public health – are germane to the organization's purpose. *See, e.g.*, *Am. Unites for Kids*, 985 F.3d at 1097 (explaining that where there is a close connection between the organization's mission and the interests of others it seeks to represent, organizational standing is appropriate); *G.G. by & through A.G. v. Meneses*, 638 F. Supp. 3d 1231, 1241 (W.D. Wash. 2022) (finding nonprofit disability rights organization had associational standing to bring claims on behalf of disabled members as rights of people with developmental disabilities was an interest the organization sought to protect).

c. The third prong is a "judicially fashioned and prudentially imposed" question, as opposed to a constitutional requirement of standing. *Or. Advocacy Ctr. v. Mink*, 332 F.3d 1101, 1109 (9th Cir. 2003). This suit is appropriately brought by a representative plaintiff; analysis under Amended TSCA focuses on scientific evidence substantiating the alleged risk to public health rather than focusing upon anecdotal evidence from plaintiffs. *See* ¶¶ 26-95; *accord Laborers Int'l Union Loc. 261 v. City & Cnty. of San Francisco*, 2022 WL 2528602, at *6 (N.D. Cal. July 6, 2022) (explaining that unlike claims seeking damages which require individualized proof, claims seeking injunctive relief are well-suited for adjudication by organizational plaintiff) (citing *Comm. for Immigrant Rts. of Sonoma Cnty. v. Cnty. of Sonoma*, 644 F. Supp. 2d 1177, 1194 (N.D. Cal. 2009)). The harm redressable herein is precisely the kind of harm that Amended TSCA is designed to address. For these reasons, the Court reaffirms its finding that requirements of standing have been satisfied.

III. FINDINGS OF FACT

23. To discern whether a chemical substance presents an unreasonable risk of injury to health or the environment, without consideration of costs or other non-risk factors, including an unreasonable risk to a potentially exposed or susceptible subpopulation, under the conditions of use, under TSCA section 6, the EPA engages in a TSCA risk evaluation process. 15 U.S.C. § 2605(b)(4); 82 Fed. Reg. 33,726 (July 20, 2017); Dkt. No. 434-18, Trial Ex. 544.

24. The TSCA risk evaluation is comprised of a risk assessment and risk determination. *See* Dkt. No. 400, Feb. 5, 2024, Trial Tr. at 653:22-655:11 (Barone). The National Research Council (NRC, 1983) has defined risk assessment as including the following components: (1) hazard assessment (including hazard identification and quantitative dose response analysis); (2) exposure assessment; and (3) risk characterization. A risk evaluation under the Amended TSCA includes the three aforementioned steps of a risk assessment, as well as a fourth and final step: (4) a risk determination. *See id.* The "risk assessment" is the scientific technical evaluation, encompassing the first three parts of this process, resulting in an unbiased, transparent, and reproducible description of the risk. *See id.* The "risk determination" is the final step of the risk evaluation process, where EPA summarizes its findings and determines whether a chemical does or does not present unreasonable risk. *See id.*

25. The following is a summary of the risk evaluation steps. *See id.*; *accord* 15 U.S.C. § 2605(b)(4)(F)(i)-(v).

a. At step 1 (hazard assessment) the EPA determines if a chemical is considered hazardous and if so, the EPA endeavors to determine the point at which the chemical becomes hazardous ("point of departure" or "hazard level"). *See* Dkt. No. 400, Feb. 5, 2024, Trial Tr. at 653:22-655:11 (Barone); *accord* 15 U.S.C. § 2605(b)(4)(F)(i)-(iii), (v).

b. At step 2 (exposure assessment) the EPA determines the level at which populations are exposed to the chemical. *See* Dkt. No. 400, Feb. 5, 2024, Trial Tr. at 653:22-655:11 (Barone);

accord 15 U.S.C. § 2605(b)(4)(F)(i)-(iii), (v).

c. At step 3 (risk characterization), the EPA compares the point of departure with the exposure level to determine if a risk is present. *See* Dkt. No. 400, Feb. 5, 2024, Trial Tr. at 575:8-583:13 (Barone). Because of uncertainty in data, the EPA establishes a margin between the point of departure and the community's exposure level. There must be a sufficient margin to find absence of risk. *See id.* The appropriate margin varies based upon how much uncertainty there is in the chosen point of departure. *See id.* The appropriate or required margin is referred to as the benchmark margin of exposure ("benchmark MOE"). *See id.* The actual margin is the actual margin of exposure ("actual MOE"). If there is an insufficient margin, *i.e.*, the actual MOE is less than the benchmark MOE, a risk has been identified. *See id.*

d. At step 4 (risk determination) if a risk is identified, the EPA will then determine if that risk is unreasonable, considering various factors such as the type of harm at issue and number of people exposed. *See* Dkt. No. 400, Feb. 5, 2024, Trial Tr. at 653:22-655:11 (Barone); *accord* 15 U.S.C. § 2605(b)(4)(F)(iii)-(v). Each step of the risk assessment is discussed in turn below.[6]

A. Step 1: Hazard Assessment

26. The Hazard Assessment step is comprised of three subparts: (a) hazard identification; (b) weight-of-the-scientific evidence; and (c) dose-response assessment. *See* Dkt. No. 400, Feb. 5, 2024, Trial Tr. at 654:19-655:11 (Barone). Each are addressed in turn below.

1. Step 1A: Hazard identification

a. *Framework*

27. The first component of the hazard assessment is hazard identification. Dkt. No. 417, Feb. 2, 2024, Trial Tr. at 489:11-17 (Barone), 656:8-661:16 (Barone). At the hazard identification step of the risk evaluation framework, the reviewer determines if an adverse effect is associated with a chemical exposure. *See* Dkt. No. 417, Feb. 2, 2024, Trial Tr. at 489:11-17 (Barone), 656:8-661:16 (Barone).

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[6] The evaluation of fluoridation chemicals under TSCA follows the same standards for demonstrating hazard and risk that EPA uses for its evaluations of other industrial chemicals under TSCA; there is no justification for holding fluoridation chemicals to a higher burden. *See* Dkt. No. 401, Feb. 6, 2024, Trial Tr. at 742:25-743:8 (Barone).

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28. Proof of causation is not required to establish a hazard of neurotoxicity, only association between the chemical exposure and the adverse effect is required for a hazard to be identified. *See id.* at 490:1-5.

29. At this stage of the process EPA reviews, searches, screens, and evaluates all studies related to different hazards to determine whether the data are sufficient or insufficient for identified adverse effects. *Id.* at 492:24-494:9.

b. <u>*Key finding*</u>

30. The hazard identification step of the hazard assessment here is satisfied; exposure to the chemical fluoride is associated with the adverse effect of reduced IQ in children, and particularly in boys.

c. <u>*Underlying findings*</u>

31. The NTP is headquartered within the National Institute of Environmental Health Sciences ("NIEHS"). Dkt. No. 440, Feb. 13, 2024, Trial Tr. at 1425:23-1426:8 (Barone). By May of 2022, the NTP completed its systematic review of fluoride, titled *NTP Monograph on the State of the Science Concerning Fluoride Exposure and Neurodevelopmental and Cognitive Health Effects: A Systematic Review* (hereafter "NTP Monograph"). Dkt. No. 431-1, Trial Ex. 67. *See also* Dkt. No. 440, Feb. 13, 2024, Trial Tr. at 1427:5-8 (Barone); Dkt. No. 400, Feb. 4, 2024, Trial Tr. at 535:15-21 (Berridge). In August 2024, the NTP Monograph was formally published. *See* Dkt No. 442 (letter from parties recognizing publishing of document). The parties agree that there are no material differences between the published Monograph and the pre-publication version that was the subject of testimony and argument at trial (*i.e.*, Trial Exhibit 67). *Id.*[7]

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[7] The parties originally filed a letter agreeing that the published version of the NTP Monograph was the same in all material respects as the Monograph this Court reviewed at trial. Dkt. No. 442. Subsequently, Plaintiffs filed a letter suggesting that certain aspects of the published NTP Monograph were modified in a way that lends *additional* support for their case. *See* Dkt. No. 443. In particular, Plaintiffs assert:

Page 101 of the now-published version of the NTP Monograph summarizes the findings of the "in-press" meta-analysis as follows:

> The group-level meta-analysis of 59 studies (n = 20,932 children) used SMD as the effect measure and reported statistically significant

32. According to the EPA, a systematic review is "a scientific investigation that focuses on a specific question and uses explicit, pre-specified methods to identify, select, assess, and summarize the findings of similar but separate studies." Dkt. No. 255 (EPA Proposed Findings of Fact, Trial Phase 1) at 15 (citing 82 Fed. Reg. at 33,734). Moreover, "[t]he goal of systemic review methods is to ensure that the review is complete, unbiased, reproducible, and transparent." *Id.* The EPA explains that a systematic review is pertinent and is ideal in conducting a risk assessment under TSCA. *See id.* at 14-19 (arguing that during the first phase of trial, before the NTP Monograph was finalized, that Plaintiffs failed to meet their burden because they did not conduct a systematic review).

33. The NTP Monograph is a systematic review as the EPA has defined that term. The NTP Monograph is a scientific investigation, focusing on a specific question using explicit, pre-

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> inverse associations between fluoride exposure measures and children's IQ. There was also a significant dose response relationship between group-level fluoride exposure and IQ. **In stratified dose-response meta-analyses of the low risk-of-bias studies, the direction of association remained consistent when group-level exposure was restricted to <4mg/L, <2 mg/L, and <1.5 mg/L fluoride in drinking water and <4 mg/L, <2 mg/L, and <1.5 mg/L fluoride in urine.** The regression slopes meta-analysis of 13 studies (n = 4,475 children) with individual-level measures of fluoride found **a significant decrease in IQ of 1.63 points (95% CI: −2.33,−0.93; p-value <0.001) per 1-mg/L increase in urinary fluoride.** In subgroup analyses of both group-level and individual level data, the direction of the association remained inverse when stratified by study quality (high versus low risk of bias), sex, age group, outcome assessment, study location, exposure timing, and exposure metric.

Dkt. No. 443 (citing *NTP Monograph on the State of the Science Concerning Fluoride Exposure and Neurodevelopment and Cognition: A Systematic Review*, National Toxicology Program (August 2024), https://ntp.niehs.nih.gov/sites/default/files/2024-08/fluoride_final_508.pdf (emphases added)).

The EPA disputes whether the post-trial version of the NTP Monograph is properly considered by this Court. *See* Dkt. No. 444. Because the Court finds in Plaintiffs favor based upon the version of the NTP Monograph that the Court reviewed at trial, and because neither party suggests the aspects of the NTP Monograph that the Court reviewed therein have changed in a way that undermines Plaintiffs' case, the Court need not resolve this dispute. Instead, the Court bases its finding upon the version of the NTP Monograph reviewed at trial (Trial Exhibit 67), though noting that it has since been published formally, and that if it were considered, it would find the published Monograph even more supportive of the decision reached herein.

specified methods. Namely, the objective of the NTP Monograph was "[t]o conduct a systematic review of the human, experimental animal, and mechanistic literature to evaluate the extent and quality of the evidence linking fluoride exposure to neurodevelopmental and cognitive effects in humans." NTP Monograph at xii (Abstract). Regarding the methods: "[a] systematic review protocol was used following the standardized OHAT [referring to the Office of Health Assessment and Translation] systematic review approach for conducting literature-based health assessments. This monograph presents the current state of evidence associating fluoride exposure with neurocognitive or neurodevelopmental health effects and incorporated predefined assessments of study quality and confidence levels. Benefits of fluoride with respect to oral health are not addressed in this monograph." *Id.* Ultimately, the NTP Monograph analyzed all available studies assessing impacts of fluoride, including seventy-two human studies that assessed the association between fluoride exposure and IQ in children and integrated the findings in the studies to draw conclusions about the impact of fluoride to neurodevelopmental and cognitive effects in humans. *Id.* at xii-xiii. Moreover, the NTP Monograph's protocol underwent multiple rounds of peer review. *Id.* at G-1. And the Monograph's substance underwent multiple rounds of peer review, including assessment of technical accuracy, and the sufficiency of evidence supporting the NTP Monograph's conclusion. *Id.* at x. The peer review panel includes professors from Brown University School of Public Health, Columbia University Medical Center, Johns Hopkins Bloomberg School of Public Health, and other epidemiological experts. *See id.* The EPA does not dispute that the NTP Monograph is likely to have captured all relevant studies that were in existence as of the Monograph's literature cutoff date analyzing human data regarding neurodevelopmental impacts of fluoride. Dkt. No. 421 at 12-13. Even before the NTP Monograph was formally published, the EPA agreed that the NTP Monograph "followed the rules that have been developed by NTP for conducting systematic reviews" and utilized a "rigorous approach to assembling the evidence," "clearly defined rules for identifying and evaluating studies," and "a well-defined protocol for drawing inferences" from the studies. *Id.*[8] Indeed,

[8] Plaintiffs submitted evidence indicating that the delay in publication was highly irregular, and perhaps politically motivated. *See* Dkt. No. 385 at 12-13. The Court excluded evidence regarding

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EPA's expert, Dr. Barone agreed that the NTP Monograph is a "high quality review." Dkt. No. 440, Feb. 13, 2024, Trial Tr. at 1427:2-4 (Barone). Accordingly, the Court finds that the NTP Monograph is probative and afforded significant weight in the risk evaluation analysis.

34. The NTP Monograph concludes that the majority of the 72 epidemiological studies on fluoride and IQ that had been published by April 2021 found an association between fluoride and reduced IQ in children, including 18 of the 19 studies the NTP Monograph deemed "high quality" and "low-risk-of-bias" as well as 46 of the 53 lower-quality studies. NTP Monograph at xii (NTP Monograph Abstract describing 46 of the 53 low-quality studies found an association between higher fluoride exposure and lower IQ in children and 18 of 19 high-quality studies reported an association between higher fluoride exposure and lower IQ in children including 3 prospective cohort studies and 15 cross-sectional studies); *accord* Dkt. No. 428-1, Trial Ex. 69 at 65 (NTP Board of Scientific Counselors Working Group Report agreeing that low-risk-of-bias studies were "consistent," meaning generating results in the same direction, in finding a negative association between fluoride exposure and children's IQ); Dkt. No. 396, Feb. 1, 2024, Trial Tr. at 313:25-314:5 (Grandjean) (summarizing and agreeing with NTP Monograph's finding that higher fluoride exposure (at or above 1.5 mg/L) was found to be associated with lower IQ scores in children in the majority of both low- and high-quality studies the NTP Monograph reviewed); Dkt. No. 414, Feb. 9, 2024, Trial Tr. at 1197:2-15 (Savitz) (expressing confidence in NTP's literature search strategy and its ability to identify all relevant studies on fluoride exposure published prior to the closing date of April 21, 2021, and confirming that the "vast majority of studies" that NTP reviewed identified an association between fluoride and reduced IQ), 1114:24-1115:1 (describing NASEM critique of adequate definition of the term "consistent" in NTP Monograph, but not disagreeing with characterization of NTP Monograph finding association between IQ and fluoride). The NTP Monograph explained its key finding regarding the impact of fluoride on children's IQ as follows:

partisanship relating to publishing of the Monograph, in large part because the EPA did not argue the Monograph be afforded less weight for its draft status. *Id.* at 17. Eventually, the NTP Monograph was published, in August 2024. *See* Dkt. No. 442.

> ***In summary, the high-quality studies (i.e., studies with low potential for bias) consistently demonstrate lower IQ scores with higher fluoride exposure [e.g., represented by populations whose total fluoride exposure approximates or exceeds the WHO Guidelines for Drinking-water Quality of 1.5 mg/L of fluoride (WHO 2017)].*** The consistency in association is observed among studies of varying study designs, exposure measures, and study populations. Although some studies that conducted multiple analyses observed within-study variations in results (e.g., differences between subsets of IQ tests), these variations were unique to individual studies and did not detract from the overall consistency in the findings that higher fluoride is associated with lower IQ scores.

Trial Ex. 67 at 47 (emphasis added).

35. To come to this conclusion: the NTP Monograph identified 19 studies as being high-quality (*i.e.*, low risk-of-bias); all but one identified an association between fluoride and reduced IQ in children: Bashash et al. 2017; Choi et al. 2015; Cui et al. 2018; Ding et al. 2011; Green et al. 2019; Rocha-Amador et al. 2007; Saxena et al. 2012; Seraj et al. 2012; Sudhir et al. 2009; Till et al. 2020; Trivedi et al. 2012; Wang et al. 2012; Wang et al. 2020b; Xiang et al. 2003a; Xiang et al. 2011; Yu et al. 2018; Zhang et al. 2015b. NTP Monograph at 40, 29-39 (Table 6). To summarize these high-quality studies:

a. Bashash (2017): This study evaluated 211 mother-child pairs that were participants in The Early Life Exposures in Mexico to Environmental Toxicants Project ("ELEMENT Cohort")[9] and concluded that higher prenatal fluoride exposure was associated with statistically

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[9] Bashash (2017) (like Green (2019) and Till (2020), discussed in subparagraphs (b) and (c)), is a longitudinal cohort study, evaluating fluoride in the urine of pregnant mothers. In such a cohort study design:

> [A] healthy group of people is assembled and followed forward in time and observed for the development of dysfunction. Such studies are invaluable for determining the time course for development of dysfunction (*e.g.*, follow-up studies performed in various cities on the effects of lead on child development). This approach allows the direct estimate of risks attributed to a particular exposure, since toxic incidence rates in the cohort can be determined. Prospective study designs also allow the study of chronic effects of exposure. One major strength of the cohort design is that it allows the calculation of rates to determine the excess risk associated with an exposure. Also, biases are reduced by obtaining information before the disease develops. This approach, however, can be very time-consuming and costly. In cohort studies information bias can be introduced when individuals provide distorted information about their health because they know their exposure status and may have been told of the expected health effects of the exposure under study.

significant lower scores on tests of cognitive function in offspring at ages 4 and 6-12 years; an increase in maternal urine fluoride of 0.5 mg/L predicted a 3.15 lower General Cognitive Index ("GCI") score and 2.50 lower IQ score of the offspring. Dkt. No. 432-2, Trial Ex. 106 at 1. ELEMENT collected urinary samples from women during pregnancy and from their children when the children were 6-12 years old (299 mother-child pairs) recruited from hospitals caring for low to moderate income populations in Mexico City. *Id.* at 1-2. The mean urinary fluoride in mothers and children was 0.90 mg/L (mothers) and 0.82 mg/L (children). *Id.* Child intelligence was measured via GCI for children at age 4 and IQ and from the Wechsler Abbreviate Scale of Intelligence ("WASI") at ages 6-12. *Id.* Fluoride exposure derived from fluoridated salt and naturally occurring fluoride in drinking water in Mexico City, ranging from 0.15 to 1.38 mg/L. *Id.* at 2. A second morning void ("spot") urine sample was targeted for collection during each trimester of pregnancy from mothers and the offspring children at time of measurements of intelligence. *Id.* A total of 1,484 prenatal samples was measured; after controlling for, *e.g.*, quality, duplicates, covariates, and outliers, 877 urine samples adjusted for creatinine were retained, stemming from 512 unique mothers. *Id.* at 3. A total of 287 mother-child pairs had complete data on exposure and outcome for children at 4 years and 211 for children at 6-12 years. Dkt. No. 434-27, Trial Ex. 656 (Savitz Summary of Methods in Key Studies of Fluoride Exposure and Neurodevelopment).

b. Green (2019): Green et al. (2019) studied mother-child pairs in Canada that were

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> More credence should be given to those studies in which both observer and subject bias are carefully controlled (*e.g.*, double-blind studies). A special type of cohort study is the retrospective cohort study, in which the investigator goes back in time to select the study groups and traces them over time, often to the present. The studies usually involve specially exposed groups and have provided much assistance in estimating risks due to occupational exposures. Occupational retrospective cohort studies rely on company records of past and current employees that include information on the dates of employment, age at employment, date of departure, and whether diseased (or dead in the case of mortality studies). Workers can then be classified by duration and degree of exposure.

Dkt. No. 429-7, Trial Ex. 17 at 17-18. Moreover, "[p]ositive or negative results from a properly controlled prospective study *should weigh heavily* in the risk assessment process." *Id.* (emphasis added).

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participants in the Maternal-Infant Research on Environmental Chemicals program ("MIREC Cohort") and found a statistically significant, negative association between fluoride exposure and IQ in boys, but not girls. Dkt. No. 432-5, Trial Ex. 109 at 940, 944. The study concluded that 1 mg/L increase in maternal urinary fluoride was associated with a 4.49-point lower IQ score in boys and 1 mg higher daily intake of fluoride among pregnant women was associated with a 3.66 lower IQ score in boys and girls. *Id.* MIREC collected urinary spot samples and estimates of daily fluoride intake from water consumption for pregnant women recruited from cities across Canada (Vancouver, Montreal, Kingston, Toronto, Hamilton, Halifax). *Id.* at 941-942. Urinary samples from the women were collected across each trimester of pregnancy; the mean maternal urinary fluoride of mothers was 0.42 mg/L in fluoridated communities and 0.27 mg/L in non-fluoridated communities. *Id.* at 944. The mean estimated intake of water fluoride concentration was 0.39 mg/day; 0.43 mg for women in communities with fluoridated drinking water and 0.26 for those living in communities without fluoridated drinking water. *Id.* Children were between ages 3 and 4 years at testing. *Id.* at 940. Data on exposure and outcome was complete for 512 mother-child pairs measuring exposure through maternal urinary fluoride and 400 mother-child pairs estimating water fluoride intake. *Id.*

c. Till (2020): Till (2020) studied samples taken from 398 mother-child pairs that participated in the MIREC Cohort project (the cohort studied in Green (2019)), to evaluate IQ of children that were breastfed compared to formula-fed as infants in areas that had fluoridated and non-fluoridated water. Dkt. No. 432-19, Trial Ex. 123 at 1. This study found that an increase in fluoride intake from infant formula corresponded to an 8.8 decrement in performance IQ which was statistically significant, including after controlling for fetal fluoride exposure. *Id.*[10]

d. Cross-sectional studies[11] of children in China found significant inverse association

[10] Till (2020) and Green (2019) exemplify how the same samples from one cohort may be analyzed in multiple studies to either confirm results from a previous study or to extract different information from the same samples from a given cohort.

[11] Cross-sectional studies are afforded less weight than cohort studies. As the EPA guidelines explain:

> In cross-sectional studies or surveys, both the disease and suspected risk factors are ascertained at the same time, and the findings are

between fluoride and children's IQ score: Xiang (2003a) (finding significant inverse correlation between IQ and urinary fluoride; significant association of fluoride on IQ score based on drinking water levels); Ding (2011) (significant association between urinary fluoride and decrease in IQ score); Xiang (2011) (significant association between serum (blood-derived sample) fluoride and reduced IQ score in children); Wang (2012) (significant correlation between total fluoride intake and reduced IQ); Zhang (2015b) (significant correlation between reduced IQ score and children's serum fluoride, and urinary fluoride), Cui (2018) (significant association between IQ score and urinary fluoride); Yu (2018) (significant difference in mean IQ scores in high water fluoride areas compared to normal water fluoride areas); and Wang (2020b) (significant negative association between IQ and water and urinary fluoride and IQ in boys and girls). NTP Monograph at 29-33 (Table 6). One study, Cui (2020) identified a directionally negative, though not statistically significant decrease in mean IQ score with increasing fluoride levels. *Id.* at 32.

e. Rocha-Amador (2007), a cross-sectional study of children in Mexico found significant associations between fluoride and IQ scores. *Id.* at 33.

f. Cross-sectional studies of children in India found significant association between fluoride and intellectual impairment: Sudhir (2009) (found a significant increase in proportion of children with intellectual impairment with increasing drinking water fluoride levels); Saxena (2012) (significant correlations between reduced IQ and water fluoride and urinary fluoride levels); Trivedi (2012) (found significantly lower mean IQ scores in high fluoride villages compares to low-fluoride villages for boys and girls combined and separately). *Id.* at 38.

g. Siraj (2012), a cross-sectional study of children in Iran found a significant negative association between water fluoride and IQ score. *Id.* at 39.

> useful in generating hypotheses. A group of people are interviewed, examined, and tested at a single point in time to ascertain a relationship between a disease and a neurotoxic exposure. This study design does not allow the investigator to determine whether the disease or the exposure came first, rendering it less useful in estimating risk. These studies are intermediate in cost and time required to complete compared with case reports and more complex analytical studies, but should be augmented with additional data.

Dkt. No. 429-7, Trial Ex. 17 at 16.

h. Soto-barreras (2019), a cross-sectional study of children in Mexico 9-10 years of age did *not* find a significant association between fluoride and IQ levels. *Id.* at 34.

36. In addition to the studies that the NTP Monograph deemed "high-quality," and thus most relevant to understanding impact of fluoride, the NTP Monograph explains that 46 of the 53 studies deemed low-quality by the NTP Monograph also found an association between fluoride exposure and reduced IQ in children. NTP Monograph at xii.

37. Several studies published after the NTP Monograph literature cut-off date (April 2021), *see* NTP Monograph at 5-12, 12 n.8, B-2, C-2-C-44, also found negative association between fluoride and IQ, and acutely, for boys – bolstering the NTP Monograph's finding of a negative association between IQ in children and fluoride exposure:

a. Goodman (2022a): studied samples from the ELEMENT cohort and concluded that an increase in maternal urinary fluoride predicated an average 2.12-point decrease in GCI scores of 4-year-olds and a 2.63 decrease in performance IQ of 6- to 10-year-olds. Dkt. No. 432-11, Trial Ex. 115 at 1-2. The study also found a marginal association with maternal urinary fluoride and verbal IQ across time. *Id.* at 2. The study concluded that visual-spatial and perceptual reasoning ability may be more impacted by prenatal fluoride exposure as compared to verbal abilities. *Id.*

b. Cantoral (2021): studied 103 mother-child pairs from the Programming Research in Obesity, Growth, Environment and Social Stressors ("PROGRESS Cohort") program. Dkt. No. 432-6, Trial Ex. 110 at 2. The PROGRESS Cohort collected data regarding dietary fluoride intake from mothers (via food and beverage) during pregnancy and neurodevelopmental testing from their offspring for 948 mother-child pairs from Mexico City. *Id.* at 2. Dietary fluoride intake was measured via food frequency questionnaires from mothers in trimesters two and three of pregnancy and children's cognitive, motor, and language outcomes were measured at 12 and 24 months. *Id.* at 1. Cantoral (2021) studied data from 103 mother-child pairs from the PROGRESS Cohort to understand if dietary fluoride intake during pregnancy is associated with toddlers' neurodevelopment. *Id.* The study found a statistically significant association between maternal fluoride intake and cognitive outcome in 24-month-old boys (0.5 mg/day increase in overall dietary fluoride intake associated with 3.5-point lower cognitive outcome). *Id.* There was no statistical association for girls or boys at 12 months of age. *Id.* Averaging across the entire age group, a 0.5 mg/day increase was associated with a 3.46-point lower cognitive outcome in boys, which was statistically significant. *Id.* The study concludes: "[t]hese findings suggest that the development of nonverbal abilities in males may be more vulnerable to prenatal fluoride exposure than language or motor abilities, even at levels within the recommended intake range." *Id.*

c. Godebo (2023): this study assessed the association between chronic exposure to naturally occurring fluoride and drinking water and cognitive function in school-aged children, measured by two distinct assessments: a drawing test with familiar objects and the Cambridge Neuropsychological Test Automated Battery, Paired Associate Leaning ("CANTAB PAL")[12] test. Dkt. No. 432-14, Trial Ex. 118 at 15-16. The population studied was recruited from eight communities exposed to chronic fluoride ranging from 0.41 to 15.5 mg/L fluoride in water sources. *Id.* at 15. The study reported adverse associations of fluoride exposure in drinking water with children's drawing and CANTAB task performance, with the most significant negative impacts observed for more challenging drawing tasks (*i.e.*, drawing a donkey rather than a house or a person). *Id.* at 16. The study concluded that this may be indicative of a greater challenge "accessing working memory for this task." *Id.*

d. Adkins (2022): this study evaluated data collected from the Cincinnati Childhood Allergy and Air Pollution Study ("CCAAPS"). Dkt. No. 432-8, Trial Ex. 112 at 1. CCAAPS collected urine samples from children at 12 years of age and collected Behavior Assessment System for Children-2 which evaluates internalizing symptoms such as anxiety depression and somatization. *Id.* at 2. The study found that higher children's urinary fluoride concentrations were significantly associated with increased somatization, but not depression or anxiety. *Id.* The study found that male participants exhibited higher internalizing and somatization behaviors relative to female participants. *Id.* at 6. The study concluded that "[d]espite males and females having comparable urinary fluoride concentrations, males may be at greater risk for adverse effects of

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[12] The tests present patterns and shapes on a screen and ask children to touch and recount the patterns to assess spatial memory and learning. Dkt. No. 432-14, Trial Ex. 118 at 10-11. Spatial memory and learning are linked to the medial temporal lobe *e.g.*, hippocampus, which the study reports is the brain region thought to be most affected by fluoride toxicity. *Id.* at 5.

fluoride exposure as the association between fluoride concentrations and internalizing symptoms was more robust among males." *Id.* at 9.

e. Risk Sciences International ("RSI"), under contract with Health Canada, also conducted an extensive systematic review of the fluoride neurotoxicity literature: Taher (2024). Dkt. No. 433-4, Trial Ex. 129; Dkt. No. 433-6, Trial Ex. 131 (Taher (2024) Supplementary Materials). Taher (2024) came to a similar conclusion as the NTP Monograph, finding a "moderate to strong magnitude (strength) of association between fluoride and neurocognitive effects with consistent evidence across studies for the impact on childhood IQ." Dkt. No. 433-4, Trial Ex. 129 at 21; Dkt. No. 433-6, Trial Ex. 131 at 1516 ("The overall evidence identified to date strongly suggests that fluoride can affect cognitive outcomes in children (specifically, reduction in IQ scores), at levels close to those currently seen in North American drinking water.").[13]

38. Other post-NTP Monograph studies did not find fluoride was associated with adverse cognitive outcomes in children:

a. Ibarluzea (2021): the study evaluated data from 316 to 248 mother-child pairs from the Infancia y Medio Ambiente cohort project ("INMA Cohort"). Dkt. No. 432-10, Trial Ex. 114 at 1. The INMA Cohort draws on data from mothers and children in Gipuzkoa, Spain (Basque Country) living in fluoridated and non-fluoridated water communities that supplied water with the mean fluoride level of 0.81 mg/L. *Id.* at 1, 3. The INMA study collected maternal urinary fluoride levels in the first and third trimesters of pregnancy, and children's cognitive domains and

[13] Unlike the NTP Monograph, Taher (2024) considered evidence relating to multiple endpoints (*i.e.*, a particular adverse effect, *see* Dkt. No. 434-15, Trial Ex. 535 at 43) aside from reduced IQ to decide which endpoints need be accounted for by regulators; endpoints considered included kidney dysfunction, sex hormone disruptions, and dental fluorosis, *see* Dkt. No. 433-4, Trial Ex. 129 at 21-23. Taher (2024) concluded that dental fluorosis and reduced IQ are critical endpoints; evidence supported the association between fluoride and those two adverse effects. *See id.* at 27. Taher (2024) did find that dental fluorosis should be the primary endpoint used by regulators because data regarding the association between dental fluorosis and fluoride was more certain than evidence regarding the association between IQ reduction and fluoride. *Id.* However, Taher (2024) explained that *both* dental fluorosis, and separately, IQ reduction in children should be considered by regulatory bodies, including the United States EPA, when assessing regulation of fluoride. *Id.* To this end, the review recommended that fluoride at 1.56 mg/L be deemed hazardous, explaining that this level should be utilized by regulators in its calculations to protect the public against *both* dental fluorosis *and* IQ reduction. *See id.* Thus, the findings of Taher (2024) are consistent with the NTP Monograph's finding that fluoride is associated with reduced IQ, particularly at exposure levels above 1.5 mg/L.

intelligence indexes, evaluated used the Bayley Scales (age 1) and McCarthy Scales (age 4). *Id.* at 1. The study concluded that per unit of maternal fluoride across the pregnancy was associated with a sizeable *increase* in IQ scores (15-point increase) and an increase in verbal, performance, numeric, and memory domains in boys. *Id.* For girls, there was no significant association between maternal fluoride and cognitive score. *Id.*

b. Dewey (2023): This study compared data collected from maternal-child pairs in Calgary, Canada pre- and post-May 19, 2011, when the city stopped fluoridating its drinking water (with a recommended level of 0.7 mg/L) to discern if fluoridated drinking water was associated with children's intelligence and executive function at 3-5 years of age. Dkt. No. 432-13, Trial Ex. 117 at 1. The study compared data from maternal-child pairs that were either fully exposed to fluoridated drinking water throughout pregnancy, exposed for part of the pregnancy, and those not exposed to fluoridated drinking water. *Id.* The study found no adverse associations between maternal exposure to fluoridated drinking water for intelligence. *Id.* at 7. The study observed that maternal exposure to fluoridated drinking water was associated with poorer executive function in preschool aged children and, particularly, girls. *Id.*

c. Do (2022): This study collected additional data from participants in Australia's National Child Oral Health Study 2012-14, which gathered data from children aged 5-10 years, and collected additional data from them again 7-8 years later but before the children turned 18 years of age. Dkt. No. 432-9, Trial Ex. 113 at 1. The study estimated lifetime exposure to fluoridated water based upon residential history and postcode-level fluoride levels in public tap water and measured children's emotional and behavioral development and executive functioning using questionnaires. *Id.* The study concluded that exposure to fluoridated water during the first 5 years of life (post-birth) was not associated with altered measures of child emotional and behavioral development and executive functioning by 18 years of age. *Id.*

39. For several reasons, the studies that did not find a negative association between fluoride and IQ, or that observed the association in some groups (boys) but not others (girls) do not undermine the significant evidence finding such an association, reflected in the NTP Monograph and studies published after the Monograph. The Court affords less weight to these studies finding

lack of an association due to various characteristics of those studies:

a. The reliability of Ibarluzea (2021) is questionable in several respects:

i. This study found that per one unit increase in the mg/L maternal urinary fluoride, there was an association with a 15-point increase in the IQ of boys associated with maternal urinary fluoride. Dkt. No. 432-10, Trial Ex. 114 at 1. Dr. Savitz, EPA's expert, agrees that this finding is an outlier and unexpected, insofar as no other study has reported a *positive* association between fluoride exposure upon IQ, and does not meaningfully support that fluoride is beneficial. *See* Dkt. No. 414, Feb. 9, 2024, Trial Tr. at 1067:2-1069:11 (Savitz) ("Again, based on what I know, I would doubt that that is an accurate reflection of the causal impact of fluoride on IQ."). Experts also testified that they were not aware of *any* other chemical known to increase the IQ of humans by 15 points. Dkt. No. 417, Feb. 2, 2024, Trial Tr. at 372:14-16 (Grandjean); Dkt. No. 395, Jan. 31, 2024, Trial Tr. at 111:4-6 (Hu). This association appears scientifically implausible and raises questions about the overall reliability of this study.

ii. Further, the 15-point increase in IQ disappeared to reflect a null finding when the maternal urinary fluoride was not adjusted for creatinine. Dkt. No. 395, Jan. 31, 2024, Trial Tr. at 109:5-11 (Hu). Adjusting maternal urinary fluoride for creatinine is standard practice, and results from creatinine-adjusted urinary fluoride are considered the informative and reliable results of a study. Dkt. No. 395, Jan. 31, 2024, Trial Tr. at 108:7-10 (Hu); Dkt. No. 414, Feb. 9, 2024, Trial Tr. at 1089:5-17 (Savitz), 1090:24-1091:2 (Savitz). However, adjusting for creatinine is expected to sharpen results, because the adjustment countervails for urinary dilution which might introduce noise into a study; the adjustment is *not*, however, expected to have any significant impact on the direction of results of the study. Dkt. No. 395, Jan. 31, 2024, Trial Tr. at 108:11-22 (Hu); Dkt. No. 417, Feb. 2, 2024, Trial Tr. at 372:25-373:22 (Grandjean), 376:15-378:24 (Grandjean). The results in the Ibarluzea (2021) study, which transitioned from a significant positive association to a null finding when urinary fluoride was adjusted for creatinine, was considered surprising and not a plausible result. Dkt. No. 395, Jan. 31, 2024, Trial Tr. at 109:13-110:7 (Hu); Dkt. No. 417, Feb. 2, 2024, Trial Tr. at 372:25-373:22 (Grandjean), 376:15-378:24 (Grandjean). Plaintiffs' experts credibly testified that this discrepancy suggests there was an error when matching fluoride and creatinine data. Dkt. No. 417, Feb. 2, 2024, Trial Tr. at 372:25-373:22 (Grandjean). EPA's experts at trial could not explain or account for this aspect of the study. Dkt. No. 414, Feb. 9, 2024, Trial Tr. at 1091:3-1093:8 (Savitz).

iii. Another concern with the Ibarluzea (2021) study is that it did not adjust for seafood as a covariate in the analysis of fluoride and IQ. Dkt. No. 397, Feb. 2, 2024, Trial Tr. at 453:12-17 (Grandjean). Seafood is both high in fluoride content and omega 3 fatty acids. Dkt. No. 395, Jan. 31, 2024, Trial Tr. at 110:20-23 (Hu). This is problematic because omega 3 fatty acids have beneficial effects on cognition, and thus seafood may be a confounding factor, skewing results of a study if the population has a high seafood ingestion rate. Dkt. No. 395, Jan. 31, 2024, Trial Tr. at 110:20-111:3 (Hu). The study did adjust for cord blood mercury levels, which could operate as an adjustment for fish consumption because fish often contain mercury. Dkt. No. 414, Feb. 9, 2024, Trial Tr. at 1073:20-1074:14 (Savitz). However, the bigger the fish, the more likely the accumulation of mercury; conversely, the smaller the fish, the less likely the accumulation of mercury. *Id.* at 1076:20-1078:9. Yet, in coastal Spain where the study was conducted, sardines and anchovies are popular, which are small fish that are lower on the food chain and accordingly low in mercury. *See* Dkt. No. 417, Feb. 2, 2024 at 458:23-459:17 (Grandjean); Dkt. No. 414, Feb. 9, 2024, Trial Tr. at 1269:24-1270:12 (Savitz). Thus, it is not clear that the adjustment for cord blood mercury levels is a sufficient proxy for seafood consumption. To this end, Dr. Savitz agreed that it is a reasonable hypothesis that fish consumption accounted for the beneficial results associated with IQ observed in the Ibarluzea (2021) study. Dkt. No. 414, Feb. 9, 2024, Trial Tr. at 1069:23-1070:18 (Savitz).

iv. Taher (2024) likewise concluded that Ibarluzea (2021) does not overcome evidence linking fluoride to reduced IQ in children. Namely, Taher (2024) concluded that "[t]he available evidence demonstrated a moderate to strong magnitude (strength) of association between fluoride and neurocognitive effects with consistent evidence across studies for the impact on childhood IQ at fluoride exposures relevant to current North American drinking water levels." Dkt. No. 433-4, Trial Ex. 129 at 21. This is because, "[f]ocusing on high quality cohort studies, most of the evidence suggests a reduction in childhood IQ scores associated with fluoride levels, though results from one 2023 study in Spain (Ibarluzea et al. 2022) documented an improvement in specific cognitive domain scores in boys." *Id.*

b. Dewey (2023) is not strong evidence regarding the association between fluoride and reduced IQ because of the design of this study. The study attempted to take advantage of what was thought to be a naturally occurring cohort with an exposure contrast (*i.e.*, one cohort exposed to fluoride and one not exposed to fluoride) to see if there was a meaningful difference in cognitive outcomes amongst the two groups. Dkt. No. 397, Jan. 31, 2024, Trial Tr. at 368:22-369:7 (Grandjean). Specifically, the study looked at individuals from a Canadian community that, for a long time, fluoridated its water and stopped fluoridating the water; the study compared the cognition of children in fluoridated and non-fluoridated groups to discern the impact of fluoride. Dkt. No. 397, Jan. 31, 2024, Trial Tr. at 368:22-369:7 (Grandjean). However, the study did not collect data on the urinary fluoride levels of the mother or assess how long pregnant mothers lived in the area prior to their pregnancy. Dkt. No. 397, Jan. 31, 2024, Trial Tr. at 368:22-369:18 (Grandjean). This is relevant because women who live in a fluoridated area throughout their lives will have fluoride which accumulates in her bones from consumption of fluoridated water, along with other sources; for several years after cessation of fluoride exposure she is likely to release accumulated fluoride from her bones into blood due to skeletal breakdown. Dkt. No. 397, Jan. 31, 2024, Trial Tr. at 370:6-371:12 (Grandjean); Dkt. No. 402, Feb. 8, 2024, Trial Tr. at 932:16-20 (Thiessen). This skeletal breakdown is particularly present during pregnancy, as the maternal skeleton dissolves itself to provide calcium to the growing fetal skeleton. Dkt. No. 395, Jan. 31, 2024, Trial Tr. at 121:10-20 (Hu). Accordingly, the group that was considered non-fluoridated in the study, thus creating an exposure contrast between the two groups allowing for a potential association to be observed, may have in fact exposed the child to fluoride during pregnancy if she lived in a fluoridated area prior to the study (a phenomenon that is not reported or considered by the study). This could lessen the exposure contrast and calls the results of the study into question. *See* Dkt. No. 397, Jan. 31, 2024, Trial Tr. at 368:22-369:18 (Grandjean). EPA's expert witnesses did not account for this concern regarding the study design. Thus, the Dewey study is accorded diminished weight.

c. Do (2022) assessed primarily behavioral outcomes rather than impact on IQ in children and, as Dr. Savitz testified, "doesn't stand out as definitive or more persuasive," relative to other studies directly on point to association of fluoride on the IQ of children. Dkt. No. 414, Feb. 9, 2024 Trial Tr. at 1106:22-1107:10 (Savitz). Plaintiffs' experts also expressed concerns with the study. The study utilized the "SDQ" test to measure impact of fluoride on children in Australia, which is a test that, for certain cultural or linguistic reasons, has been determined to be unreliable for Australians by another study conducted by the co-author of Do (2022). Dkt. No. 397, Jan. 31, 2024, Trial Tr. at 364:8-14, 365:15-366:4 (Grandjean). EPA's expert witness did not rebut evidence that there were significant problems with the validity of the SDQ test in Australia. Dkt. No. 415, Feb. 12, 2024, Trial Tr. at 1240:1-6 (Savitz). Further, the value of this study is weakened because it did not analyze individualized data, but instead measured exposure based on residence of the child and community-wide data on fluoride in that area. *See* Dkt. No. 396, Feb. 1, 2024, Trial Tr. at 240:17-19 (Lanphear) (explaining that individualized data is generally a strength of a study); Dkt. No. 417, Feb. 2, 2024, Trial Tr. at 366:5-367:4, 367:15-368:4 (Grandjean). Lack of individualized data can lead to exposure imprecision, creating "noise" in the data, which may bias results toward the null, *i.e.*, noise makes it less likely to show an association between the chemical and a result. Dkt. No. 395, Jan. 31, 2024, Trial Tr. at 106:18-107:16 (Hu); Dkt. No. 396, Feb. 1, 2024, Trial Tr. at 281:14-17 (Lanphear), 281:24-282:3 (Lanphear), 317:16-24 (Grandjean); Dkt. No. 414, Feb. 9, 2024, Trial Tr. at 1176:4-17 (Savitz) (agreeing with a statement made in his textbook that in general exposure misclassification tends to produce results with a bias towards the null). Thus, this study is not particularly probative evidence as to association between fluoride and IQ of children.

40. EPA experts agreed, in line with the NTP Monograph's conclusion, that fluoride is associated with adverse IQ in children at "higher" levels of exposure. Namely, Dr. Barone testified that he agreed that there is "something going on" at higher-dose levels, though unclear about where the threshold is. Dkt. No. 415, Feb. 12, 2024, Trial Tr. at 1372:9-1373:9 (Barone). Dr. Barone agreed that, at 4 mg/L of fluoride exposure and above, there is more data to support a finding of an adverse effect associated with fluoride. *Id.* at 1373:1-9 (Barone). Dr. Barone further

testified: "I agree with the NTP's conclusions that at some level above 1.5 mg/L that there is moderate evidence to support an association between fluoride and developmental IQ decrements." Dkt. No. 416, Feb. 12, 2024, Trial Tr. at 1428:4-11 (Barone).[14] The primary concern presented by EPA's experts relates to lack of clarity as to whether *lower* exposure levels of fluoride (below 1.5 mg/L) results in an adverse outcome and the precise relationship between dose and response. *See* Dkt. No. 415, Feb. 12, 2024, Trial Tr. at 1357:9-1360:10 (Barone). For example, Dr. Savitz (EPA's expert witness) did not opine that the NTP Monograph's main conclusion that fluoride is presumed to be a cognitive neurodevelopmental hazard to humans was incorrect, though expressing concerns as to a previous draft of the Monograph regarding whether its conclusion was well explained and qualified. Dkt. No. 414, Feb. 9, 2024, Trial Tr. at 1113:16-1115:23 (Savitz) ("Whether [a committee reviewing a draft of the NTP Monograph] agreed with [the NTP Monograph's conclusion] was not the issue. It was – the story that gets to the punchline at the end we did not find persuasive."). Indeed, Dr. Savitz explained that he does not have a basis to challenge the NTP's conclusion that, with moderate confidence, there is an association or appears to be an association between neurological decrements in fluoride concentrations above 1.5 mg/L. *Id.* at 1140:10-19 (Savitz) ("I don't have any reason to challenge [this conclusion], but I haven't corroborated it by going through the dozens of studies one-by-one to make my own assessment."). Dr. Savitz likewise made clear he did not undertake a complete review of the NTP Monograph, but testified his primary concern was the Monograph's "inferences regarding lower levels of fluoride exposure." *Id.* at 1129:11-1131:3 (Savitz).

41. The robust body of scientific literature systematically assessed by the NTP Monograph (described above, ¶ 35) and literature published after the NTP Monograph cutoff date (described above, ¶ 37), even considering some countervailing scientific literature (described above, ¶¶ 38-39) establishes by a preponderance of the evidence that fluoride is associated with reduced IQ in

[14] Dr. Barone testified that the NTP Monograph was helpful but not complete and thus insufficient to satisfy the hazard identification prong of TSCA hazard assessment. Dkt. No. 440, Feb. 13, 2024, Trial Tr. at 1428:22-1429:3 (Barone). That testimony is not credible because it directly contradicts Dr. Barone's prior testimony during his deposition that the literature the NTP reviewed through April 2021 was sufficient to satisfy the human evidence standard for identifying a hazard under the EPA's TSCA guidelines. *Id.* at 11-21.

children – at least at "higher" concentration levels, *i.e.*, above 1.5 mg/L (measured in either water fluoride levels or urinary fluoride levels). At the hazard identification step, the EPA does not require showing that an adverse effect is present at the level akin to the exposure in the community (*i.e.*, 0.7 mg/L) or require the establishment of a dose-response relationship of the chemical at "lower" levels. Dkt. No. 417, Feb. 2, 2024, Trial Tr. at 493:16-495:12 (Barone). The evidence regarding the "higher" exposure levels is sufficient to satisfy the hazard identification step of the analysis.

42. Regardless, scientific literature in the record also indicates there is an association between fluoride and reduced IQ in children even at "lower" levels of exposure (*i.e.*, below 1.5 mg/L).

43. Two of the three high-quality studies that evaluated the effects of "lower" levels of fluoride exposure (below 1.5 mg/L) did observe an association between fluoride and reduced IQ in children or boys. Namely: (1) Bashash (2017), studied mother-child pairs from the ELEMENT Cohort (Mexican population) and observed a statistically significant decrement of 3.15 GCI score and 2.5 IQ score of offspring per an increase of 0.5 mg/L of maternal urinary fluoride where the mean maternal urinary fluoride in mothers was **0.9 mg/L**, Dkt. No. 432-2, Trial Ex. 106 at 1; and (2) Green (2019) studied mother-child pairs in the MIREC Cohort (Canadian population) and found a statistically significant decrement of 3.66 IQ score in boys only (3.66 IQ score decrement per a 1 mg/L per day increase in maternal urinary fluoride) where the mean maternal urinary fluoride of mothers was **0.42 mg/L**, Dkt. No. 432-5, Trial Ex. 109 at 1-3, 5.

44. Another program collected samples from 837 mother-child pairs from the Odense municipality in Denmark: the Odense Child Cohort ("OCC Cohort"). Dkt. No. 432-15, Trial Ex. 119 at 1. The OCC Cohort measured maternal urinary fluoride during pregnancy and the IQ of school-aged offspring of those mothers. *Id*. The maternal urinary fluoride concentrations averaged at **0.58 mg/L** per day. *Id.* at 2. The study, when accounting for covariables did **<u>not</u>** observe a statistically significant association between maternal urinary fluoride and child Full-Scale IQ score, with no clear interaction between sex and fluoride exposure. *Id.*

45. The result of the OCC Cohort does not negate the findings regarding the MIREC and ELEMENT cohorts. It is inherently more difficult to observe an adverse effect of a chemical at

lower exposure levels because of reduced exposure contrast[15] at those levels. Dkt. No. 395, Jan. 31, 2024, Trial Tr. at 113:2-25 (Hu), 114:8-14 (Hu); Dkt. No 396, Feb. 1, 2024, Trial Tr. at 213:5-25 (Lanphear); Dkt. No. 400, Feb. 5, 2024, Trial Tr. at 525:9-526:13 (Berridge). EPA's expert, Dr. Savitz, agreed. Dkt. No. 402, Feb. 8, 2024, Trial Tr. at 1009:7-23 (Savitz) ("[Y]ou could think of the worst cases, if we all had the exact same value, everybody in the population had the same exposure, you could not do an informative study of the association of exposure with a disease. And if it's very narrow, of course, you're only able to study – if you're only able to study, let's say, the contrast of, you know, .4 and .5 milligrams per liter fluoride, you're going to have a tough time, even if there were an effect, it's going to be difficult to find because you have a very limited contrast. As you spread that out more, of course, you are – you have a larger contrast and you're able to address a more informative range of exposure."). It is particularly difficult to observe effects of fluoride at lower exposure levels because of challenges in finding a control group with zero or very little fluoride exposure. Dkt. No 396, Feb. 1, 2024, Trial Tr. at 212:7-213:25 (Lanphear). This is because fluoride exposure is prevalent. Some common sources aside from fluoridated water include naturally occurring fluoride in food and beverage, fluoride in food and beverage made with fluoridated water, and other products, like toothpaste. *Id*. at 212:10-19 (Lanphear). Thus, it is difficult to find a control group without any fluoride exposure; the "noise" created by background fluoride exposure tends to obscure the contrast between those who consume fluoridated water and those who do not. *Id*. at 212:19-23 (Lanphear) ("And so if we wanted to ask a question . . . is there a difference in children who are unexposed to fluoride? Well, we really can't find children who are unexposed to fluoride versus kids who have levels in a nonfluoridated community or a fluoridated community."). It is thus more challenging to observe

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[15] Exposure contrast refers to the difference between exposure of a chemical in one group (a control group) and another group (the group exposed to the chemical). Dkt. No. 395, Jan. 31, 2024, Trial Tr. at 113:6-22 (Hu). For example, an observer would compare a group with less or no fluoride exposure to a group with more exposure to determine if there is a meaningful difference in the group with more exposure. *See* Dkt. No 396, Feb. 1, 2024, Trial Tr. at 212:10-23 (Lanphear). When trying to observe effects of a chemical at lower levels, there is less "exposure contrast" between the control group and exposed group. *See id.* at 212:10-213:25. Dr. Hu provided an illustration: "It's sort of like looking at, you know, a picture and trying to determine whether this shade is different from that shade. If you increase the contrast, it's easier to see." Dkt. No. 395, Jan. 31, 2024, Trial Tr. at 114:12-14 (Hu).

effects at lower concentration levels of fluoridated water. *Id*. at 212:24-213:25 (Lanphear). Accordingly, the Court finds convincing and credible the expert testimony that studies analyzing the OCC Cohort are not inconsistent with studies analyzing the ELEMENT and MIREC Cohorts; the lower exposure levels account for some difficulty in repeating observed effects. Dkt. No. 395, Jan. 31, 2024, Trial Tr. at 116:24-117:4 (Hu).[16] In short, the association between intake of water at lower fluoridated levels and IQ is likely harder to detect. Inconsistent results between studies are not unexpected. The two high-quality studies which detected such an association at lower concentration levels of fluoride remain significant and are not undermined by the OCC Cohort study.

46. In conclusion, Plaintiffs have established by a preponderance of the evidence that exposure to fluoride is associated with the adverse effect of reduced IQ in children, and particularly, young boys. Hence, the hazard identification step of the analysis is satisfied.

2. Step 1B: Weight of the scientific evidence

a. *Framework*

47. Once a hazard has been identified, the EPA assesses the weight of the scientific evidence, wherein the risk assessor considers the weight of that evidence, determining which adverse effects (endpoints) are to be assessed, and which studies are appropriate for use in quantifying the relationship between the dose of the chemical and adverse effect(s) (response) at issue (the "dose-response" assessment). Dkt. No. 400, Feb. 4, 2024, Trial Tr. at 661:18-666:14 (Barone). To this end, not all studies are appropriately utilized in the dose-response assessment. *See* Dkt. No. 417, Feb. 2, 2024, Trial Tr. at 494:17-495:12 (Barone). Rather, the EPA identifies the studies from the hazard identification step that are generally of high or medium quality, and thus are deemed permissible to use in the dose-response assessment. *Id.* at 494:17-495:12; Dkt. No. 421 at 5 (undisputed fact).

[16] Expert witnesses also testified credibly that there are some possible explanations for the differing study results; for example, it is possible that Denmark has higher iodine consumption, accounting for the discrepancy, as iodine deficiency is theorized to be an aggravating factor for impacts of fluoride on neurodevelopment. *See* Dkt. No. 396, Feb. 1, 2024, Trial Tr. at 248:10-250:3 (Lanphear).

48. The parties disagree as to precisely how the weight-of-the-scientific evidence analysis intersects with the subsequent step of the analysis: the dose-response assessment wherein a point of departure[17] is identified (Step 1C, discussed in Section III.A.3.). *See* Dkt. No. 421 at 22-23. Plaintiffs assert that the weight-of-the-scientific evidence analysis is a distinct, qualitative characterization of the evidence regarding a "chemical's potential to produce neurotoxicity," separate from the quantitative dose-response assessment wherein a point of departure is calculated (Step 1C, discussed in Section III.A.3). *Id.* The EPA asserts that there is not a clear distinction between the qualitative and quantitative dose-response assessment. *See id.* Dr. Barone, EPA's expert does recognize that risk evaluation includes a "quantitative track wherein the agency is doing a quantitative measurement, deriving a point of departure, and a qualitative track where [the assessor is] assessing whether that evidence is appropriate for that purpose." *See* Dkt. No. 400, Feb. 4, 2024, Trial Tr. at 666:9-14 (Barone). Moreover, Dr. Barone stated that: "in this weight of the scientific evidence evaluation . . . [we ask] how much data do we actually have for that particular endpoint or that particular outcome, and are there a series of outcomes that are related to neurotoxicity that we should consider as an example or reproductive toxicity. So we may have multiple endpoints to consider and multiple studies within that, that can be ***carried forward*** to dose response." *Id.* at 662:2-19 (emphasis added). This testimony intimates that the weight-of-scientific-evidence analysis occurs prior to, and separately from, the quantitative dose-response assessment wherein a point of departure is calculated. *See id.* However, to avoid any doubt, the Court assesses the weight-of-the-scientific evidence both as a standalone, qualitative issue, characterizing the weight of the evidence assessing the association between the chemical and endpoint (in this section of the analysis (Section III.A.2., as Step 1B)) and also assesses the weight-of-the-scientific-evidence, as part of the quantitative dose-response assessment wherein a point of departure is identified (Section III.A.3, as Step 1C, discussed below).

b. *Key finding*

49. The weight of the scientific evidence regarding fluoride's association with reduced IQ is

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[17] As explained in depth in Section III.A.3., the point of departure represents the level at which the chemical at issue becomes hazardous.

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sufficient to proceed to the dose-response assessment; the evidence in the record is appropriate for use in calculating a point of departure.

c. *Underlying findings*

50. The term "weight of the scientific evidence" is supported by EPA's systematic analysis of the related information to support the Agency's findings. *Id.* at 651:22–652:5; *accord* 40 CFR 702.33. The assessor uses the "best available science," in the analysis, which means that TSCA risk evaluations need to be unbiased and objective, and the methodologies employed must be transparent and reproducible and generally peer reviewed. Dkt. No. 400, Feb. 5, 2024, Trial Tr. at 652:6-16 (Barone); *accord* 40 C.F.R. 702.33.

51. In the weight-of-the-scientific-evidence analysis, generally, high- or medium-quality studies are adequate to move to the dose-response determination. Dkt. No. 417, Feb. 2, 2024, Trial Tr. at 494:17-495:12 (Barone); Dkt. No. 421 at 5 (undisputed fact). Still, the EPA sometimes carries over low-quality studies into the dose-response analysis as well. Dkt. No. 417, Feb. 2, 2024, Trial Tr. at 494:21-495:1 (Barone). In this weight-of-the-scientific-evidence analysis, some or all factors referred to as the "Bradford Hill" factors may be considered. Dkt. No. 400, Feb. 5, 2024, Trial Tr. at 626:8-24 (Barone). The nine Bradford Hill factors are: (1) strength of the association, (2) consistency of the association; (3) specificity of the association; (4) temporality of the association; (5) biological gradient (*i.e.*, dose response) of the association; (6) plausibility of the association; (7) coherence of the association, (8) experimental support for the association, and (9) analogies for the association. *See* Dkt. No. 198-3, Grandjean Trial Decl. ¶¶ 111-125. However, there is no mandate that each of the Bradford Hill factors be considered in the weight-of-the-evidence assessment in a non-cancer TSCA risk evaluation such as this one. *See* Dkt. No. 437-1, Trial Ex. 96 (hereinafter "PCE Risk Evaluation") at 326 (considering only consistency of association factor); Dkt. No. 437-7, Trial Ex. 102 (hereinafter "Methylene Risk Evaluation") at 285-95 (considering some, but not all, of the Bradford Hill factors).

52. As discussed previously, not every epidemiological study on fluoride has found associations with reduced IQ in children. *See* ¶¶ 35, 38. However, the evidence at issue is overall **consistent** as to the finding that fluoride is associated with reduced IQ in children, and there is a

vast amount of **experimental support** for the association:

a. The NTP Monograph studied a robust amount of literature regarding fluoride's impact on children's IQ: 72 epidemiological studies – 19 of which were deemed "high quality" and "low-risk-of-bias," and 53 lower-quality studies – a large majority of which identified an association between fluoride and reduced IQ. NTP Monograph at xii (describing that 46 of the 53 low-quality studies found an association between higher fluoride exposure and lower IQ in children and 18 of 19 high-quality studies reported an association between higher fluoride exposure and lower IQ in children including 3 prospective cohort studies and 15 cross-sectional studies). Indeed, when narrowing evidence to view only 19 studies that are high quality and low risk-of-bias, all but one identified an association between fluoride and reduced IQ: Bashash et al. 2017; Choi et al. 2015; Cui et al. 2018; Ding et al. 2011; Green et al. 2019; Rocha-Amador et al. 2007; Saxena et al. 2012; Seraj et al. 2012; Sudhir et al. 2009; Till et al. 2020; Trivedi et al. 2012; Wang et al. 2012; Wang et al. 2020b; Xiang et al. 2003a; Xiang et al. 2011; Yu et al. 2018; Zhang et al. 2015b). NTP Monograph at 29-40 (Table 6).

b. The findings of the NTP Monograph are properly afforded substantial weight. The NTP is headquartered within NIEHS, which is "is one of the premier environmental health sciences research institutions in the world." Dkt. No. 440, Feb. 13, 2024, Trial Tr. at 1425:23-1426:2 (Barone). The EPA does not dispute this fact. Dkt. No. 421 at 10. Even before the NTP Monograph was formally published, the EPA agreed the NTP Monograph is a high-quality review, followed rules that have been developed by NTP for conducting systematic review, had a "rigorous approach to assembling the evidence," "clearly defined rules for identifying and evaluating studies," and "a well-defined protocol for drawing inferences" from the studies. Dkt. No. 440, Feb. 13, 2024, Trial Tr. at 1427:9-21 (Barone), 1427:2-8 (Barone).

c. Though there were some critical peer review comments on earlier drafts of the NTP Monograph, the core conclusion of the NTP Monograph regarding the high-quality studies was not called into question by reviewers. *See, e.g.*, Dkt. No. 438-1, Trial Ex. 69 at 65 (NTP Board of Scientific Counselors Working Group Report agreeing that low-risk-of-bias studies were "consistent," meaning generating results in the same direction, in finding a negative association between fluoride exposure and children's IQ); Dkt. No. 414, Feb. 9, 2024, Trial Tr. at 1114:24-1115:1 (Savitz) (describing NASEM critique of adequate definition of the term "consistent" in NTP Monograph, but not disagreeing with characterization of NTP Monograph finding association between IQ and fluoride). Indeed, EPA's experts at trial expressed confidence in the NTP Monograph's methodologies. Dkt. No. 414, Feb. 9, 2024, Trial Tr. at 1197:2-15 (Savitz) (expressing confidence in NTP's literature search strategy and its ability to identify all relevant studies on fluoride exposure published prior to the closing date of April 21, 2021, and agreeing that the "vast majority of studies" that NTP reviewed identified an association between fluoride and reduced IQ). *See also* Dkt. No. 414, Feb. 9, 2024, Trial Tr. at 1140:10-19 (Savitz) ("I don't have any reason to challenge [this conclusion], but I haven't corroborated it by going through the dozens of studies one-by-one to make my own assessment."). Further, Dr. Savitz, the expert called by the EPA herein, acknowledged he is not an expert in conducting risk assessment, and particularly not under Amended TSCA. Dkt. No. 415, Feb. 9, 2024, Trial Tr. at 1264:2-6 (Savitz). Formal publication of the NTP Monograph affirms its quality. *See also* ¶ 33.

d. As explained previously, studies published after the NTP Monograph's literature cut-off date likewise observed a negative association between fluoride and children's cognition: Goodman (2022(a)), Cantoral (2021), Godebo (2023), and Adkins (2022)). *See* ¶ 37.

e. Further, notwithstanding difficulties in observing effects of a chemical at lower levels, *see* ¶ 45, adverse outcomes have even been observed at those levels with statistical significance: Green (2019) and Bashash (2017), ¶¶ 42-43.

f. As explained previously, some studies have not observed an association between fluoride and reduced IQ: Soto-barreras (2019), ¶ 35(h); Ibarluzea (2021), ¶ 38(a); Dewey 2023, ¶ 38(b); Do (2022), ¶ 38(c); and the OCC Cohort, ¶ 44. However, complete consistency amongst studies is not expected. Dkt. No. 414, Feb. 9, 2024, Trial Tr. at 1172:23-1173:6 (Savitz). To this end, various co-factors or susceptibilities can influence the impact or manifestation of neurotoxicants, and as such, it is to be expected that there will be some variability in results across studies of different populations. *See id.* What may appear to be a discrepant result may, in fact, reflect unmeasured differences in cofactors that influence the course of a chemical's neurotoxicity. *See* Dkt. No. 395, Jan. 31, 2024, Trial Tr. at 102:22-104:24 (Hu); Dkt. No. 417, Feb. 1, 2024, Trial Tr. at 242:21-243:9 (Lanphear), 328:14-23 (Grandjean). And, as also explained previously, particular characteristics of these studies finding null outcomes render them less probative here. *See* ¶ 39. Namely, Ibarluzea (2021) found an unrealistic 15-point IQ benefit, included unexplained and implausible results regarding creatinine adjustments, and failed to control for seafood, ¶ 39(a); Dewey (2023) did not account for previous residence of mothers or continued excretion of fluoride from skeletal breakdown during pregnancy in the control group, ¶ 39(b); Do (2022) utilized an unreliable IQ test and did not analyze individualized data, ¶ 39(c); and the OCC Cohort measured lower exposure levels which makes it more difficult to observe adverse effects, ¶ 45.

53. Though not definitive, there is additional evidence that supports the **plausibility** of the association by assessing potential *mechanisms* for fluoride to impact IQ. Specifically, studies have endeavored to consider explanations for the observed association between fluoride and IQ and hypothesize that thyroid disruption may be the mechanism by which fluoride impacts cognitive function:

a. Goodman (2022b) studied samples from the MIREC Cohort to assess the three-way interplay between prenatal fluoride exposure, maternal iodine status, and child IQ. Dkt. No. 432-12, Trial Ex. 116 at 1, 8. The study found that the negative association between fluoride exposure and IQ observed in Green (2019) was exacerbated by low maternal iodine in pregnancy among boys. *Id.* The study hypothesized that change in thyroid function may be a mechanism by which fluoride impacts cognition; iodine impacts thyroid function. *Id.* at 1-2.

b. Hall (2023): studied samples from the MIREC Cohort and concluded that fluoride in drinking water was associated with increased risk of hypothyroidism in pregnant women, and that thyroid disruption may contribute to developmental neurotoxicity of fluoride. Dkt. No. 432-16, Trial Ex. 120 at 1-2.

54. A lack of a dose-response relationship in the data may suggest that the effect is not related to the putative neurotoxic effect or that the study was not appropriately controlled. Dkt. No. 429-7, Trial Ex. 17 (Guidelines for Neurotoxicity Risk Assessment, Fed. Reg. 63(93):26926-26954

(hereinafter "EPA Guidelines"))[18] at 50. As discussed in the next section regarding the dose-response assessment, there is some lack of clarity as to the precise dose-response relationship at lower exposure levels of fluoride. However, evidence indicates that there is no **threshold** by which fluoride and adverse IQ cease to be associated. *See* ¶¶ 42-43.

55. In conclusion, this evidence is sufficient to proceed to the dose-response assessment of the analysis. *Cf.* Methylene Risk Evaluation at 262 (conducting dose-response analysis for Methylene under Amended TSCA based upon one animal study).

3. Step 1C: Dose-response assessment

a. *Framework*

56. The point at which the chemical ceases to be safe is known as the "point of departure" (*i.e.*, "POD") or "hazard level." *See* Dkt. No. 429-20, Trial Ex. 38 at 1; Dkt. No. 417, Feb. 2, 2024, Trial Tr. at 495:9-14 (Barone); Dkt. No. 421 at 5. To this end, the dose-response assessment describes the relationship between dosage of the chemical and a response, and endeavors to identify the dosage at which a chemical is safe, and conversely, becomes hazardous; this is the point of departure. *See* EPA Guidelines at 57. *See also* Dkt. No. 429-20, Trial Ex. 38 at 1 (describing that the objective of the dose-response assessment is to "document the relationship between dose and toxic effect").

57. There are different points of departure that can be used in a risk assessment. EPA Guidelines at 57-58. The first approach is the NOAEL/LOAEL approach. *See* Dkt. No. 429-19, Trial Ex. 38 at 3-4. A No-Observed-Adverse-Effect Level ("NOAEL") is the "highest exposure level at which no statistically or biologically significant increases are seen in the frequency or severity of adverse effect between the exposed population and its appropriate control population." *Id.* at 4. In cases in which a NOAEL cannot be identified, the term lowest-observed-adverse-effect level ("LOAEL") is used, which is the lowest dose tested at which an adverse effect is detected.

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[18] These Guidelines were published in April 1998 and are the currently applied guidelines for EPA Neurotoxicity Risk Assessment according to the EPA's website. *See Guidelines for Neurotoxicity Risk Assessment*, UNITED STATES ENVIRONMENTAL PROTECTION AGENCY (last visited September 12, 2024), https://www.epa.gov/risk/guidelines-neurotoxicity-risk-assessment.

Id. at 4. Alternatively, when possible, the benchmark dose ("BMD") approach can be used to arrive at a point of departure. *Id.*

58. The BMD approach is preferred over the NOAEL/LOAEL approach, and use of a NOAEL is preferred over the LOAEL. *Id. See also* Dkt. No. 417, Feb. 2, 2024, Trial Tr. at 495:23-496:25 (Barone); EPA Guidelines at 2-3, 57-58; Dkt. No. 421 at 5 (undisputed fact). The NOAEL/LOAEL approach derives the point of departure from a dosage and corresponding response in subjects that was actually observed. *See* EPA Guidelines at 57-59. *See also* Dkt. No. 400, Feb. 5, 2024, Trial Tr. at 672:1-11 (Barone) ("So generally a NOAEL or LOAEL, as we described earlier, comes directly from what is the observed concentration for an effect or no effect. So it's directly coming from the study of where that threshold for non-cancer – generally gets a threshold – where does that concentration occur. And that's describing, generally speaking, a single dose. It's within the dose continuum of how many doses were employed in the study, what concentration did they measure an effect."). *See also* EPA Guidelines at 57-59. The NOAEL/LOAEL is thus limited to only dosages observed in the study. *See* EPA Guidelines at 57-59. Other limitations of the NOAEL/LOAEL approach include that this approach is highly dependent upon sample size of a study (*e.g.*, where a sample size is limited, it might present a higher point of departure than the true point of departure), and it does not account for the shape of the dose-response curve from the experiment at issue. *Id.* Because of these limitations, the BMD approach is preferred if the data set is appropriate for such modeling. *See* Dkt. No. 429-20, Trial Ex. 38 at 4; Dkt. No. 400, Feb. 5, 2024, Trial Tr. at at 479:14-580:9 (Barone).

59. In utilizing the BMD approach, a benchmark dose, *i.e.*, BMD or benchmark concentration ("BMC") is identified. *See* Dkt. No. 429-20, Trial Ex. 38 at 4. The BMD/BMC is the dose of a substance that produces a "predetermined change in the response rate of an adverse effect." *Id.* The benchmark dose level ("BMDL") or benchmark concentration level ("BMCL") is the lower end of the statistical confidence limit on the dose that produces the selected response. *Id.* In other words, there is a statistical confidence interval on either side of the BMD/BMC; the BMDL/BMCL is the point at the lower side of that confidence interval. *See id.* Like the NOAEL/LOAEL, the BMCL/BMDL can be used as the point of departure. *Id.*

b. *Key findings*

60. 0.28 mg/L, or alternatively, 0.768 and/or 1.536 mg/L measured in maternal urinary fluoride is associated with a 1-point decrease in IQ of girls and boys and is a legitimate point of departure (BMCL) to use in this risk evaluation.

61. Alternatively, 4 mg/L measured in either urinary fluoride or water fluoride, is a legitimate, conservative point of departure (LOAEL) to use in the risk evaluation.

62. Regarding the weight of the scientific evidence, the quality and weight of the evidence in the record substantiates points of departure derived from either BMD modeling of the data or from a LOAEL/NOAEL approach.

c. *Underlying findings*

(a) POD: 0.28 mg/L BMCL (Grandjean (2023)) or in the alternative, 0.768 mg/L and/or 1.536 mg/L BMCL (Grandjean (2022))

63. Dr. Philippe Grandjean ("Grandjean") was the lead author of two pooled BMCL analyses, one published in 2022 and another in 2023. Dkt. No. 432-20, Trial Ex. 124. (hereinafter "Grandjean (2022)"); Dkt. No. 432-15, Trial Ex. 119 (hereinafter "Grandjean (2023)").

64. Dr. Grandjean and his co-authors are well-regarded for their benchmark dose analyses. To this end, EPA cited a pooled benchmark dose analysis authored by Grandjean as an example of how to perform such an analysis in its Benchmark Dose Technical Guidance Manual, and EPA has relied upon the authors' benchmark dose analysis work in its assessment of other chemicals. Dkt. No. 417, Feb. 2, 2024, Trial Tr. at 287:16-288:18 (Grandjean), 479:25-5 (Grandjean); Dkt. No. 401, Feb. 6, 2024, Trial Tr. at 748:19-750:6 (Barone).

65. Grandjean (2022) analyzed data from two cohorts, the ELEMENT Cohort and the MIREC Cohort to conduct its BMCL analysis. Grandjean (2022) at 1-2. Grandjean (2023) analyzed three cohorts: ELEMENT, MIREC, and the OCC cohorts. Grandjean (2023) at 1.

66. The pooled BMCL analyses of the birth cohorts sought to determine the level of fluoride in maternal urine ("MUF") that is associated with a 1-point drop in the IQ of the mothers' offspring. Dkt. No. 417, Feb. 1, 2024, Trial Tr. at 339:13-23 (Grandjean). As described by RSI, "[t]he choice of a BMR of 1 IQ point (corresponding to a 1% reduction from a mean IQ of 100)

has been adopted as an appropriate benchmark on this endpoint by several regulatory bodies, including the US EPA and EFSA." Dkt. No. 433-4, Trial Ex. 129 at 27. Pooled analyses are also particularly useful because a pooled analysis benefits from heightened statistical power and precision that comes from large samples sizes. Dkt. No. 395, Jan. 31, 2024, Trial Tr. at 111:9-112:16 (Hu).

67. Grandjean (2023) concluded that "[t]he joint analysis of all three cohorts showed a statistically significant association between urine-fluoride and IQ, with a BMC of 0.45 mg/L (BMCL, 0.28 mg/L)." Grandjean (2023) at 1-2. Specifically, Grandjean (2023) found that the BMCL associated with a 1-point decrease in IQ scores of boys and girls was 0.28 mg/L maternal urinary fluoride; this BMCL was adjusted for creatinine and derived from use of a linear dose-response model. Grandjean (2023) at 1-2, 9. This BMCL is a legitimate point of departure to use in the risk evaluation for fluoride.

68. When determining whether the point of departure can be derived using the BMD or BMC approach, as opposed to identifying a LOAEL or NOAEL, it is necessary to consider whether the data set is appropriate for use in the BMD/BMC modeling. *See* Dkt. No. 400, Feb. 5, 2024, Trial Tr. at 658:9-659:10 (Barone) (explaining that in identifying studies and key endpoints to "carry forward to the dose-response analysis," the assessor considers whether "are [the studies] amenable to BMDS, benchmark dose modeling? Are they amenable to a LOAEL/NOAEL approach? Should we use some other type of approach?"). To this end, the EPA's technical guidance provides that the following should be considered as to whether the data set is appropriate for BMD modeling: (1) whether there is a statistically or biologically significant dose-related trend in the selected endpoint; (2) whether a response is not only seen at a high dose; and (3) where there are adequate model fits. *See* Benchmark Dose Technical Guidance, U.S. ENVIRONMENTAL PROTECTION AGENCY (June 2012) available at https://www.epa.gov/sites/default/files/2015-01/documents/benchmark_dose_guidance.pdf (hereinafter "EPA's Benchmark Dose Technical Guidance") at 12-18.[19]

[19] This document was not submitted as an exhibit, but the EPA's witnesses rely on the document for their testimony. *See, e.g.*, Dkt. No. 401, Feb. 6, 2024, Trial Tr. at 745:9-25 (Barone) ("Q:

69. For the reasons discussed below, the data that Dr. Grandjean analyzed is appropriate for use in BMD modeling, and for similar reasons, his point of departure is supported by the weight of the scientific evidence. *See* ¶ 51 (discussing weight-of-scientific-evidence factors). It is demonstrated by a preponderance of the evidence.

70. As explained previously, there is a well-supported and documented, statistically significant dose-related trend in the selected endpoint (reduced IQ). *See* ¶¶ 52-53 (discussing the robust body of evidence establishing the relationship between fluoride and reduced IQ, including studies observing this relationship at "lower" exposure levels).

71. Dr. Grandjean rests his BMCL analysis upon studies observing the ELEMENT, MIREC, and OCC cohorts. Grandjean (2023) at 1-2. These high-quality studies are appropriate for use in BMD modeling, particularly because they include data regarding dose-response at "lower" exposure levels, *i.e.*, 0.9 mg/L (mean maternal urinary fluoride in ELEMENT cohort), 0.42 mg/L (mean maternal urinary fluoride in MIREC cohort), and 0.58 mg/L (average maternal urinary fluoride in the OCC cohort). *See* ¶¶ 42-44. Thus, rather than observing only a response at high dosages, the data set utilized by Dr. Grandjean observes dose-response at low exposure levels. The data set are thus appropriate for BMD modeling. To this end, RSI found that the MIREC and ELEMENT cohorts represent a "high quality of evidence partly based on Canadian population, conducted within a context relevant to Canadian drinking water fluoride exposure levels.[20] Both studies included prospective data collection, with prenatal exposure assessment (maternal urine collection over successive trimesters) and follow-up during the early life of the infants and children." Dkt. No. 433-4, Trial Ex. 129 at 23. And the ELEMENT and MIREC cohort studies

Now, moving beyond semantics, I wanted to ask you about your testimony about benchmark dose, okay? You made comments in your testimony about Dr. Grand[j]ean's BMCL analysis, correct? A. Yes, I did. Q. You based your comments on EPA's BMD guidance technical manual, correct? A. Yes, I did."). The Court thus considers this technical guidance document.

[20] The United States and Canada take a similar approach to water fluoridation; this finding is applicable to United States drinking water fluoride exposure levels. *See* Tr. Ex. 129, Dkt. No. 433-4 at 16 (describing optimal water fluoride levels in Canada of 0.7 mg/L). *See also* Dkt. No. 396, Feb. 1 , 2024 Trial Tr. at 245:1-22 (Lanphear) (describing optimal 0.7 mg/L water fluoride standard in Canada).

are strong for their extensive control for covariates and individualized measurements of fluoride exposure during the prenatal period. Dkt. No. 395, Jan. 31, 2024, Trial Tr. at 95:2-96:5 (Hu).

72. The model fits of the data utilized by Grandjean's BMCL are also adequately supported. On this point, the EPA takes issue with the fact that Dr. Grandjean's BMCL of 0.28 mg/L was derived by applying a linear model of the dose-response curve.[21] Grandjean (2023) at 1-2, 9. To discern the best model fit for a set of data, a model is used to find a fit to the data, and based upon that fit, an "AIC" score is generated; the lower the AIC score, the better the model fit. Dkt. No. 417, Feb. 2, 2024, Trial Tr. at 421:20-21 (Grandjean). To EPA's point, Grandjean (2023) did not include a published table illustrating the AIC scores for all model fits, but did so only for the linear model and piece-wise model, though not the squared model. *See* Grandjean (2023) at 9 (Table S3). The government thus argued at trial that Dr. Grandjean improperly assumed, without testing the assumption, that the linear model was appropriate for the data set evaluated. However, the use of the linear model in Grandjean (2023) to generate the BMCL is sufficiently justified:

i. Dr. Grandjean testified, and the Court finds this testimony credible, that he did not assume that the linear model was the best fit, but rather that he and his co-authors compared various models and determined that the linear model was the preferred model for the data. Dkt. No. 396, Feb. 1, 2024, Trial Tr. at 333:6-19 (Grandjean). Dr. Grandjean did state that "[i]n my communications with the EPA, I was told that the default curve function was the linear one." *Id.* at 333:8-9. However, Dr. Grandjean clarified that this default was only a starting point

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[21] When a curve is linear, generally the dose and effect increase or decrease in a somewhat uniform fashion, *i.e.*, when the dose increases, the effect increases; when the dose decreases, the effect decreases. *See* EPA's Benchmark Dose Technical Guidance at 25-26, 77-78 (describing linear, quadratic, and other models), 71 (defining "Linear Dose-Response Model" as "[a] mathematical relationship in which a change in response is proportional to a fixed amount of change in dose, e.g., Response = a + b × Dose. This is in distinction from a more general linear mathematical model, which is a linear combination of parameters"). The shape of the dose-response curve is relevant, particularly because it is used to extrapolate to lower levels of exposure not observed in the study, and thus to calculate the BMCL. *See id.* at 5 ("The dose response assessment under the guidelines is a two-step process: (1) response data are modeled in the range of empirical observation — modeling in the observed range is done with biologically based or curve-fitting models; and then (2) extrapolation below the range of observation is accomplished by modeling, if there are sufficient data, or by a default procedure (linear, nonlinear, or both)."). The model will thus determine the BMCL identified. *See id.* at 5, 25-26, 77-78.

and that "what we've done in our work is to compare that to some variations and the statistical methods so that you can actually compare the fit if, let's say, curvilinear or a broken line fits better. And in our case the linear was actually – was the best fit." *Id.* at 333:10-14. And further, Dr. Grandjean testified that he also used "nonlinear methods to assess whether the dose-response relationship is linear," *id.* at 333:15-19. *See also id.* at 339:24-340:7 ("We started out with EPA's default recommendation, namely that linear association. But we then also looked at a curvilinear, for example, log 2 transformation of exposure. We also looked at broken lines of – and overall the linear association was not inferior to anything. It was sometimes clearly superior."); Dkt. No. 417, Feb. 2, 2024, Trial Tr. at 440:23-419:1 (Grandjean) ("[W]e certainly did look at other models."). Dr. Grandjean and his co-authors did not simply assume that the linear model was the best fit for the data. It was chosen through an analytical process.

ii. Moreover, Grandjean (2022) includes a table that reports the AIC scores for squared models as they fit to data from the MIREC and ELEMENT cohorts and reveals comparable fit scores and supports Dr. Grandjean's testimony as to the validity of the linear model fit:

Table 2.

Benchmark Concentration Results (mg/L Urinary Fluoride, Creatinine-Adjusted) for a BMR of 1 IQ Point Obtained from the MIREC Study and the Two Cognitive Assessments from the ELEMENT Study as Well as the Joint Results. Two Concentration-Response Models are used, a Linear and One with the Squared Exposure Variable. For both Models, Sex-Specific and joint benchmark Results are Provided. The fit of the Regression models was Compared by the AIC (Where Lower Values Indicate a Better Fit)

Study		MIREC ($n = 407$)		ELEMENT IQ ($n = 211$)		ELEMENT GCI ($n = 287$)		MIREC and ELEMENT IQ ($n = 618$)			MIREC and ELEMENT GCI ($n = 694$)		
Model	Sex	BMC	BMCL	BMC	BMCL	BMC	BMCL	BMC	BMCL	AIC	BMC	BMCL	AIC
Linear	Both	0.497	0.228	0.200	0.122	0.159	0.099	0.326	0.201	4770.1	0.312	0.192	5491.3
Linear	Boys	0.201	0.125	0.275	0.130	0.148	0.084	0.222	0.144	4766.7	0.184	0.125	5488.4
Linear	Girls	∞	0.609	0.160	0.091	0.169	0.087	1.098	0.275	4766.7	2.972	0.315	5488.4
Squared	Both	1.545	0.896	0.614	0.496	0.611	0.467	1.008	0.768	4768.8	1.133	0.807	5493.9
Squared	Boys	0.840	0.622	0.684	0.496	0.581	0.435	0.787	0.619	4769.4	0.761	0.601	5493.7
Squared	Girls	∞	1.262	0.576	0.449	0.642	0.434	1.637	0.866	4769.4	∞	1.040	5493.7

Abbreviations: AIC, Akaike Information Criterion; BMC, benchmark concentration; BMCL, benchmark concentration level; BMR, benchmark response; GCI, Global Cognitive Index; IQ, Intelligence Quotient.

Grandjean (2022) at 17 (Table 2) (red annotation added). The AIC scores for the linear and squared models were comparable, with the best fit for boys and girls individually, measuring IQ, using a linear model (AIC 4766.7 linear compared to 4769.4 squared), and squared combined (AIC 4768.8 squared compared to 4770.1 linear). *See id.* For GCI (the General Cognitive Index score), the linear model was a better fit than the squared model for all categories. *See id.* Even if not definitive, the comparable AIC fits for linear and squared models reflected in Grandjean (2022) support that the linear model is a justifiable model to apply to the MIREC and ELEMENT cohort data.

iii. Dr. Grandjean's analysis is also consistent with the NTP's analysis. The NTP Meta-analysis did not publish AIC scores for models restricted to low-risk-of bias studies. *See* Dkt. No. 431-2, Trial Ex. 68 at 40-41 (eTable 4) (hereinafter "NTP Meta-analysis"). However, it did publish AIC scores for model fit of data in all studies, as reflected in the below table:

Exposure Analysis	Parameters	Fluoride Exposure			
		All data	<4 mg/L	<2 mg/L	<1.5 mg/L
Urinary Fluoride – All Studies					
No. Studies/No. Observations Number of Children		18/32 8,502	13/26 6,885	7/11 4,654	5/8 3,992
Linear Model[b]	Beta (95% CI) p-value AIC	−0.16 (−0.24, −0.08) p < 0.001 AIC = 73.8	−0.17 (−0.30, −0.05) p = 0.005 AIC = 68.0	−0.06 (−0.14, 0.01) p = 0.094 AIC = 1.2	−0.09 (−0.16, −0.01) p = 0.026 AIC= 2.8
Quadratic Model[c]	Beta (95% CI); p-value Beta (95% CI); p-value AIC p-value*	−0.10 (−0.31, 0.11); p = 0.360 −0.01 (−0.05, 0.02); p = 0.496 AIC = 84.3 p* = 0.14	0.07 (−0.23, 0.38); p = 0.645 −0.07 (−0.16, 0.01); p = 0.071 AIC = 75.8 p* = 0.08	−0.22 (−0.65, 0.20); p = 0.303 0.08 (−0.13, 0.30); p = 0.456 AIC = 9.2 p* = 0.42	0.65 (−1.46, 2.76); p = 0.548 −0.66 (−2.11, 0.80); p = 0.379 AIC = 8.3 p* = 0.10
Restricted Cubic Splines Model[d]	Beta (95% CI); p-value Beta (95% CI); p-value AIC p-value*	−0.12 (−0.28, 0.04); p = 0.150 −0.10 (−0.43, 0.23); p = 0.545 AIC = 79.6 p* = 0.13	−0.03 (−0.22, 0.16); p = 0.741 −0.24 (−0.47, −0.002); p = 0.048 AIC = 73.3 p* = 0.07	−0.14 (−0.32, 0.04); p = 0.130 0.13 (−0.17, 0.43); p = 0.395 AIC = 8.5 p* = 0.37	−0.52 (−1.65, 0.62); p = 0.371 0.63 (−1.32, 2.59); p = 0.524 AIC = 6.7 p* = 0.07

Id. Using urinary fluoride as the exposure metric, the linear model reflected the lowest AIC score unilaterally. *See id.* And although the linear model did not generate a statistically significant inverse association at all exposure levels, the linear model generated a statistically significant inverse association at <1.5 mg/L (in line with Grandjean (2023)'s finding relating to lower-exposure levels as noted above), and the findings remained directionally negative at all levels which also supports Grandjean (2023)'s use of the linear model. *See* Dkt. No. 395, Jan. 31, 2024, Trial Tr. at 115:16-25 (Hu) ("In fact, epidemiology is moving away from a simple reliance on just P values and saying 'this is significant, this is not significant.' It's really important to also look at the so-called directionality of the relationships."). Additionally, as explained in more detail below, some of the loss of association observed in the NTP Meta-analysis may be explained by the use of the means effect method in the Meta-analysis, which results in loss of statistical power and sensitivity in the data. *See* ¶ 74(b). Ultimately, the authors of the NTP Meta-analysis concluded that "[b]ased on the AIC and likelihood ratio tests, the best model fit was achieved when quadratic or restricted cubic spline exposure levels were added to the linear models for drinking water (eFigure 17); ***the linear model was the best fit for urinary fluoride*** (eFigure 18)." NTP Meta-analysis at 10 (emphasis added). This further bolsters the legitimacy of Grandjean (2023)'s use of a linear model to generate the BMCL, expressed in maternal urinary fluoride.

73. Assuming, in the alternative, that the squared model is a more appropriate fit for this data set, as EPA suggested at trial, a BMCL of 0.768 mg/L and/or 1.536 mg/L is appropriately used to conduct the risk assessment. Though Grandjean (2023) did not identify a BMCL using the squared model, Dr. Grandjean's 2022 BMCL analysis did identify a BMCL of 0.768 mg/L utilizing a squared model. Grandjean (2022) at 17 (Table 2); Dkt. No. 417, Feb. 2, 2024, Trial Tr. at 423:12-21 (Grandjean). It is true that this BMCL is derived from the ELEMENT and MIREC cohort data only and excludes data from the OCC Cohort. This is relevant because inclusion of the OCC Cohort data is likely to increase the BMCL; when the OCC cohort data was added to the BMCL analysis in Grandjean (2023), the BMCL increased by 0.08 mg/L, or forty percent[22] (from 0.20 mg/L (MIREC and ELEMENT alone) to 0.28 mg/L (MIREC, ELEMENT and OCC cohort data)). *See* Grandjean (2023) at 3 ("The joint BMC was found to be 0.45 mg/l (BMCL, 0.28 mg/l), *i.e.* slightly higher than previously found (BMC, 0.33 mg/l; BMCL, 0.20 mg/L) for the two North American cohorts alone."). But a preponderance of the evidence indicates the inclusion of the OCC Cohort data would not make a material difference. To be highly conservative, the BMCL of 0.768 mg/L can be *doubled*, to account for any discrepancy caused by the omission of the OCC data: 1.536 mg/L (0.768 mg/L times two). This could be used conservatively as an alternative point of departure implied from the data if the squared model is used. As discussed below, even using this higher point of departure, the ultimate finding of an unreasonable risk would not change.

[22] ((.08 / .20) * 100).

74. One additional concern with Dr. Grandjean's BMCL calculation is that it, at first glance, appears to be in tension with the NTP Monograph's conclusion that "[m]ore studies are needed to fully understand the potential for lower fluoride exposure [i.e., below 1.5 mg/L] to affect children's IQ." NTP Monograph at xiii.[23] However, this ultimately does not undermine the validity of the BMCL identified in Grandjean (2023) for the following reasons:

a. Though the authors of the NTP Monograph recognized some lack of clarity in the precise relationship between fluoride and reduced IQ at lower exposure levels, NTP Monograph at xiii, given the strength of the association between fluoride and reduced IQ, the authors of the NTP Monograph refused to limit the applicability of its findings in the systematic review to higher exposure levels and made clear that its confidence assessment also considered fluoride exposures "that are similar to, or lower than, those associated with optimally fluoridated water supplies in the United States," *i.e.*, 0.7 mg/L. Dkt. No. 438-1, Trial Ex. 69 at 24-25 (comments and responses from NTP Monograph authors and evaluators of the NTP Monograph).

b. The NTP also conducted a Meta-analysis, integrating all of the studies assessed in the NTP Monograph to analyze the dose-response relationship between fluoride and reduced IQ. The findings of the NTP Meta-analysis first appear to be in tension with Dr. Grandjean's findings but are, in fact, consistent with those findings because of the methodologies used. Namely, the NTP Meta-analysis concluded that "the consistency of the data supports an inverse association between fluoride exposure and children's IQ." NTP Meta-analysis at 3. However, the Meta-analysis reported somewhat mixed results regarding the dose-response relationship, particularly at

[23] Regarding "lower" fluoride exposure levels – both Grandjean (2023) and the NTP Monograph analyzed data from the ELEMENT and MIREC cohorts though Grandjean (2023) also analyzed data from the OCC Cohort, another lower-exposure level study.

lower levels of fluoride exposure:

Exposure Analysis	Parameters	Fluoride Exposure			
		All data	<4 mg/L	<2 mg/L	<1.5 mg/L
Linear model	Beta (95% CI) p-value AIC	−0.15 (−0.23, −0.07) p < 0.001 AIC = 74.5	−0.16 (−0.28, −0.04) p = 0.011 AIC = 68.6	−0.05 (−0.14, 0.04) p = 0.259 AIC = 1.3	−0.08 (−0.16, −0.01) p = 0.036 AIC = 3.0
Urinary Fluoride – Low Risk-of-bias Studies					
No. Studies/No. Observations Number of Children		9/15 5,713	9/15 5,713	5/8 4,141	4/7 3,952
Linear model	Beta (95% CI) p-value AIC	−0.10 (−0.21, 0.01) p = 0.082 AIC = 5.9	−0.10 (−0.21, −0.01) p = 0.082 AIC = 5.9	−0.05 (−0.17, 0.08) p = 0.472 AIC = 2.8	−0.08 (−0.16, −0.01) p = 0.028 AIC = 2.5

Id. at 41 (eTable 4) (red annotation added). In reviewing all studies and measuring exposure of fluoride per urinary fluoride the NTP Meta-analysis found a statistically significant inverse association between children's urinary fluoride exposure and IQ at <4 mg/L urinary fluoride. *Id.* When restricted to <2 mg/L and <1.5 mg/L urinary fluoride, there was still an inverse association. *Id.* This finding is consistent with Grandjean (2023). However, when analyses were restricted to low risk-of-bias publications, the associations at <2 mg/L and <1.5 mg/L became smaller in magnitude and were only statistically significant at <1.5 mg/L, but not at <2 mg/L. *Id.* That finding of an adverse association at <1.5 mg/L is consistent with the conclusion in Dr. Grandjean's pooled benchmark dose analysis (though appearing somewhat anomalous compared to the finding at <2 mg/L). Dr. Grandjean's pooled benchmark analysis uses a method with more statistical precision than the NTP Meta-analysis, and thus could account for the more specific findings as to the relationship between fluoride and IQ at lower exposure levels. Specifically, the NTP Meta-analysis used a "means effect analysis," which is useful for its ability to compare different types of studies with varied methodologies and metrics (72 total and 19 low-risk-of-bias studies) – but it loses sophistication and precision in the underlying data of each study when it converts the findings into standard, comparable metrics. Dkt. No. 417, Feb. 2, 2024, Trial Tr. at 469:3-471:6 (Grandjean). Specifically, so that different studies using different exposures or result metrics could be compared, the data was grouped into buckets (*e.g.*, high exposure, low exposure) and analyzed. *Id.* at 471:6-15. Accordingly, each of the underlying studies lose some of its statistical power when data is simplified to allow for cross-study, like-to-like comparison. *See id.* at 471:6-473:24. On the other hand, the pooled benchmark analysis maintains individualized, continuous

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data and does not simplify that data for meta-analysis comparison; the benchmark analysis maintains increased sophistication and statistical sensitivity. *Id.* at 473:18-24. Thus, the findings of the NTP Meta-analysis are not inconsistent with Dr. Grandjean's pooled benchmark analysis.

75. Ultimately, TSCA does not require complete certainty as to the threshold level at which a chemical produces the hazard; indeed, such certainty is very difficult to obtain from epidemiologic studies of human populations. Dkt. No. 440, Feb. 13, 2024, Trial Tr. at 1440:18-23 (Barone); Dkt. No. 414, Feb. 9, 2024, Trial Tr. at 1173:7-13 (Savitz). Either BMCL of 0.28 mg/L (linear model per the MIREC, ELEMENT, and OCC cohort data) or 0.768 mg/L (squared model per the MIREC and ELEMENT cohort data) identified by Dr. Grandjean and his co-authors are legitimate points of departure to utilize in a risk analysis. So is the implied BMCL of 1.536 mg/L (were the OCC study taken into account). The Court finds, though not with absolute certainty, Dr. Grandjean's BMCLs are supported by a preponderance of the evidence.[24]

(b) <u>POD: 4 mg/L urinary or water fluoride (LOAEL)</u>

76. As described previously, use of the BMD approach is preferred in identifying a point of departure because of limitations of a NOAEL or LOAEL, but where data is not amenable to benchmark dose modeling, a NOAEL or LOAEL may be utilized instead. *See* ¶¶ 57-59. The Court thus examines this alternative approached to establishing a point of departure.

77. Again, notwithstanding the limitations of the NOAEL/LOAEL approach, this approach is properly used, and has been used by the EPA, with the application of uncertainty factors, to determine the point of departure where datasets are, for various reasons, not amenable to BMD modeling. *See* Dkt. No. 429-20, Trial Ex. 38 at 4. For example, the EPA conducted a risk evaluation of Perchloroethylene ("PCE"), pursuant to Amended TSCA, and utilized NOAEL/LOAELs as PODs because it was unable to use BMD modeling. *See* PCE Risk Evaluation at 351 ("For this risk evaluation, non-cancer PODs were all based on NOAELs and LOAELs because the data for the selected endpoints was unable to be BMD modeled. This results

[24] The government also takes issue with the use of maternal urinary fluoride ("MUF") as the metric of the exposure or hazard level utilized in the risk assessment analysis. The validity of maternal urinary fluoride as a metric is taken up subsequently in Section III.B (Exposure Assessment).

in reduced precision in POD estimates because the POD is dependent on the dose selection of the study as opposed to the response rate/level for the effect of interest."); Dkt. No. 401, Feb. 6, 2024, Trial Tr. at 772:3-11 (Thiessen).

78. To the extent that the BMD approach is not appropriate based upon the present data set, in the alternative, 4.0 mg/L (using exposure measurement of water fluoride intake) is a legitimate and highly conservative LOAEL to utilize as a point of departure to conduct a risk assessment of fluoride per the findings of the NTP Meta-analysis. Utilizing 4.0 mg/L as the LOAEL is especially conservative in view of the NTP Monograph's conclusion with moderate confidence that exposure to fluoride concentration in drinking water at or above 1.5 mg/L is associated with lower IQ in children. One could reasonably take 1.5 mg/L as a LOAEL. Nonetheless, the Court uses the more conservative 4.0 mg/L based on a close analysis of the NTP Meta-analysis which establishes with consistency an association with reduced IQ at that level. Specifically, the NTP Meta-analysis observed a statistically significant inverse association between fluoride and reduced IQ at 4 mg/L measured in water fluoride, based on low-risk-of-bias/high quality studies (*i.e.*, 6 epidemiological studies deemed high quality), which is reflected in the below table from the Meta-

analysis summarizing the NTP's dose-response analysis:[25]

eTable 4. Dose-Response Meta-analysis Using Mean Effects—Model Selection[a]

Exposure Analysis	Parameters	Fluoride Exposure: All data	<4 mg/L	<2 mg/L	<1.5 mg/L
Water Fluoride – All Studies					
No. Studies/No. Observations Number of Children		29/39 11,656	21/27 8,723	7/9 2,971	7/7 2,832
Linear Model[b]	Beta (95% CI) p-value AIC	−0.15 (−0.20, −0.11) p < 0.001 AIC = 53.8	−0.22 (−0.27, −0.17) p < 0.001 AIC = 16.1	−0.15 (−0.41, 0.12) p = 0.274 AIC = 11.8	0.05 (−0.36, 0.45) p = 0.816 AIC = 8.2
Quadratic Model[c]	Beta (95% CI); p-value Beta (95% CI); p-value AIC p-value*	−0.27 (−0.34, −0.21); p < 0.001 0.02 (0.01, 0.03); p < 0.001 AIC = 48.8 p* < 0.001	−0.12 (−0.35, 0.11); p = 0.318 −0.04 (−0.10, 0.03); p = 0.280 AIC = 21.2 p* = 0.012	0.79 (−0.01, 1.58); p = 0.052 −0.56 (−0.97, −0.16); p = 0.006 AIC = 12.5 p* = 0.007	0.30 (−0.53, 1.14); p = 0.477 −0.23 (−1.01, 0.55); p = 0.561 AIC = 11.3 p* = 0.04
Restricted Cubic Splines Model[d]	Beta (95% CI); p-value Beta (95% CI); p-value AIC p-value*	−0.29 (−0.39, −0.20); p < 0.001 0.48 (0.18, 0.78); p = 0.002 AIC = 42.3 p* < 0.001	−0.14 (−0.34, 0.06), p = 0.162 −0.23 (−0.66, 0.20), p = 0.295 AIC = 16.9 p* = 0.009	1.15 (0.07, 2.22) p = 0.037 −1.20 (−2.03, −0.36) p = 0.005 AIC = 10.5 p* = 0.010	0.49 (−0.50, 1.47) p = 0.334 −0.69 (−2.40, 1.02) p = 0.428 AIC = 10.2 p* = 0.05
Water Fluoride – Low Risk-of-bias Studies					
No. Studies/No. Observations Number of Children		6/11 4,355	6/9 4,251	3/4 921	3/3 879
Linear model	Beta (95% CI) p-value AIC	−0.19 (−0.34, −0.05) p = 0.009 AIC = 10.3	−0.22 (−0.36, −0.07) p = 0.003 AIC = 3.9	−0.34 (−0.72, 0.03) p = 0.070 AIC = 4.5	−0.32 (−0.91, 0.26) p = 0.276 AIC = 4.1

Dkt. No. 431-2, Trial Ex. 68 at 39 (eTable4) (red annotation added). That value was derived from a linear model which, for this group of studies, had the lowest AIC score. *See id.* (identifying AIC of 16.1 (linear for all studies), 21.1 (quadratic for all studies), 16.9 (restricted cubic splines for all studies)).

[25] Note that where values in the parenthesis, which represent the confidence interval, are below zero, the finding is statistically significant. *See* Dkt. No. 417, Feb. 2, 2024, Trial Tr. at 394:2-14 (Grandjean).

79. Further, the NTP Meta-analysis observed an association between fluoride and reduced IQ at <4 mg/L measured in urinary fluoride, based on low-risk-of-bias/high-quality studies (9 epidemiological studies deemed high quality):

Exposure Analysis	Parameters	Fluoride Exposure			
		All data	<4 mg/L	<2 mg/L	<1.5 mg/L
Urinary Fluoride – All Studies					
No. Studies/No. Observations Number of Children		18/32 8,502	13/26 6,885	7/11 4,654	5/8 3,992
Linear Model[b]	Beta (95% CI) p-value AIC	−0.16 (−0.24, −0.08) p < 0.001 AIC = 73.8	−0.17 (−0.30, −0.05) p = 0.005 AIC = 68.0	−0.06 (−0.14, 0.01) p = 0.094 AIC = 1.2	−0.09 (−0.16, −0.01) p = 0.026 AIC= 2.8
Quadratic Model[c]	Beta (95% CI); p-value Beta (95% CI); p-value AIC p-value*	−0.10 (−0.31, 0.11); p = 0.360 −0.01 (−0.05, 0.02); p = 0.496 AIC = 84.3 p* = 0.14	0.07 (−0.23, 0.38); p = 0.645 −0.07 (−0.16, 0.01); p = 0.071 AIC = 75.8 p* = 0.08	−0.22 (−0.65, 0.20); p = 0.303 0.08 (−0.13, 0.30); p = 0.456 AIC = 9.2 p* = 0.42	0.65 (−1.46, 2.76); p = 0.548 −0.66 (−2.11, 0.80); p = 0.379 AIC = 8.3 p* = 0.10
Restricted Cubic Splines Model[d]	Beta (95% CI); p-value Beta (95% CI); p-value AIC p-value*	−0.12 (−0.28, 0.04); p = 0.150 −0.10 (−0.43, 0.23); p = 0.545 AIC = 79.6 p* = 0.13	−0.03 (−0.22, 0.16); p = 0.741 −0.24 (−0.47, −0.002); p = 0.048 AIC = 73.3 p* = 0.07	−0.14 (−0.32, 0.04); p = 0.130 0.13 (−0.17, 0.43); p = 0.395 AIC = 8.5 p* = 0.37	−0.52 (−1.65, 0.62); p = 0.371 0.63 (−1.32, 2.59); p = 0.524 AIC = 6.7 p* = 0.07
Urinary Fluoride – Sensitivity analysis including Ibarluzea et al. (2021)[87] Bayley MDI scores					
No. Studies/No. Observations Number of Children		19/33 8,815	14/27 7,445	8/12 4,967	6/9 4,305
Linear model	Beta (95% CI) p-value AIC	−0.15 (−0.23, −0.07) p < 0.001 AIC = 75.0	−0.15 (−0.28, −0.03) p = 0.015 AIC = 69.0	−0.04 (−0.14, 0.05) p = 0.371 AIC = 1.7	−0.08 (−0.15, −0.003) p = 0.043 AIC = 3.6
Urinary Fluoride – Sensitivity analysis including Ibarluzea et al. (2021)[87] McCarthy GCI scores					
No. Studies/No. Observations Number of Children		19/33 8,749	14/27 7,445	8/12 4,901	6/9 4,239
Exposure Analysis	**Parameters**	**Fluoride Exposure**			
		All data	**<4 mg/L**	**<2 mg/L**	**<1.5 mg/L**
Linear model	Beta (95% CI) p-value AIC	−0.15 (−0.23, −0.07) p < 0.001 AIC = 74.5	−0.16 (−0.28, −0.04) p = 0.011 AIC = 68.6	−0.05 (−0.14, 0.04) p = 0.259 AIC = 1.3	−0.08 (−0.16, −0.01) p = 0.036 AIC = 3.0
Urinary Fluoride – Low Risk-of-bias Studies					
No. Studies/No. Observations Number of Children		9/15 5,713	9/15 5,713	5/8 4,141	4/7 3,952
Linear model	Beta (95% CI) p-value AIC	−0.10 (−0.21, 0.01) p = 0.082 AIC = 5.9	−0.10 (−0.21, −0.01) p = 0.082 AIC = 5.9	−0.05 (−0.17, 0.08) p = 0.472 AIC = 2.8	−0.08 (−0.16, −0.01) p = 0.028 AIC = 2.5

Dkt. No. 431-2, Trial Ex. 68 at 39 (eTable 4) (red annotation added). That value was also derived from a linear model which, for this group of studies, likewise had the lowest AIC score. *See id.* (identifying 68 (linear for all studies), 75.8 (quadratic for all studies), 73.3 (restricted cubic splines for all studies)).

80. Even if there may be some uncertainty about the dose-response relationship below that exposure level (4 mg/L), significant data supports that there is an adverse effect *at or above the specified level*. *See* Dkt. No. 415, Feb. 12, 2024, Trial Tr. at 1373:1-9 (Barone) (testimony from

Dr. Barone agreeing that at 4 mg/L of fluoride exposure and above there is relatively more data to support a finding of an adverse effect associated with fluoride.), 1428:4-11 (Barone) ("I agree with the NTP's conclusions that at some level above 1.5 that there is moderate evidence to support an association between fluoride and developmental IQ decrements."). Again, TSCA does not require absolute certainty as to the threshold level at which a chemical produces the hazard, and indeed as noted above such certainty is very difficult to obtain from epidemiologic studies of human populations. Dkt. No. 440, Feb. 13, 2024, Trial Tr. at 1440:18-23 (Barone); Dkt. No. 414, Feb. 9, 2024, Trial Tr. at 1173:7-13 (Savitz). In view of the record evidence, 4 mg/L as the lowest-observed-effect-level would be a conservative point of departure to utilize in the analysis; it is certainly well-supported by scientific evidence as described in the conclusion of the NTP Monograph: "the high-quality studies (*i.e.*, studies with low potential for bias) consistently demonstrate lower IQ scores with higher fluoride exposure [*e.g.*, represented by populations whose total fluoride exposure approximates or exceeds the WHO Guidelines for Drinking-water Quality of 1.5 mg/L of fluoride (WHO 2017)]." NTP Monograph at 47.

81. The EPA has identified a LOAEL based upon far less evidence than that in the record before this Court. In the EPA's risk evaluation of Methylene, conducted pursuant to Amended TSCA, it used a LOAEL for developmental neurotoxicity, derived from the analysis of ***one study conducted upon mouse pups*** (Fredriksson et al., 1992). *See* Methylene Risk Evaluation at 262. Here, there are between six and nine[26] high-quality, epidemiological studies of human populations underlying the point of departure. Dkt. No. 431-2, Trial Ex. 68 at 39, 41 (eTable 4).

82. To restate, in conclusion, either the LOAEL of 4.0 mg/L, measured either in urinary fluoride or water fluoride, or the BMCL of 0.28 mg/L, 0.768 mg/L, or even 1.536 mg/L measured in maternal urinary fluoride, is a well-supported point of departure to utilize in the risk evaluation. Each of these measures of the point of departure is supported by a preponderance of high-quality evidence.

[26] Six studies measuring fluoride exposure by way of water fluoride and nine studies measuring urinary fluoride. Dkt. No. 431-2, Trial Ex. 68 at 39, 41 (eTable 4).

B. Step 2: Exposure Assessment

a. *Framework*

83. At this step, the EPA conducts an exposure assessment to identify the exposure level under the conditions of use for the chemical at issue. Dkt. No. 400, Feb. 5, 2024, Trial Tr. at 567:18-568:2 (Barone); 15 U.S.C. § 2605(b)(4)(F)(iv) ("In conducting a risk evaluation under this subsection, the Administrator shall . . . take into account, where relevant, the likely duration, intensity, frequency, and number of exposures under the conditions of use of the chemical substance."). Namely, the EPA identifies sources of exposure to the chemical (*e.g.*, food or water), estimates what the intake level of exposure is, and endeavors to understand and characterize the population that is exposed. Dkt. No. 401, Feb. 6, 2024, Trial Tr. at 694:4-695:11 (Barone).

84. To understand the level of exposure, the EPA estimates a range of exposure levels for a condition of use from the central tendency exposure (*e.g.*, 50th percentile) to high-end exposure (*e.g.*, 95th percentile). Dkt. No. 400, Feb. 5, 2024, Trial Tr. at 649:1-650:10 (Barone), 697:15-698:6 (Barone); *see also* EPA Guidelines at 64 (describing consideration of upper percentile exposure and highest-exposed individuals in risk assessment).

85. As discussed in depth in the next section (Section III.C), the exposure level is important because it is used to calculate whether the chemical presents a risk to humans. Specifically, in the next step of the analysis (risk characterization), the exposure level is compared to the point of departure to determine if a risk is present. *See* Dkt. No. 401, Feb. 6, 2024, Trial Tr. (Barone) at 705:7-706:21. At that step, the EPA determines the appropriate margin that needs to exist from the point of departure (*i.e.*, point at which the chemical becomes hazardous). *See id.* This is the benchmark Margin of Exposure ("MOE"). *See id.* The benchmark MOE is calculated by multiplying the point of departure by Uncertainty Factors ("UFs") to account for assumptions or uncertainty in the data. *See id.* The benchmark MOE is then compared to the actual MOE, *i.e.*, the existing margin between the exposure level and the point of departure, to determine if that margin is sufficient. *See id.*

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b. *Key findings*

86. For reasons discussed below, **maternal urinary fluoride** is an appropriate metric to use in conducting the risk evaluation of fluoride under the condition of use, *i.e.*, community water fluoridation at 0.7 mg/L.

87. Pregnant mothers in fluoridated communities in the United States have a median exposure level to fluoride of **0.8 mg/L**, measured in **maternal urinary fluoride**; at the 95th percentile,[27] pregnant mothers have an exposure level to fluoride of **1.89 mg/L**, measured in **maternal urinary fluoride**. Approximately half of these maternal urinary fluoride levels is attributed to community water fluoridation.

88. Alternatively, the exposure levels of **0.7 mg/L,** or **0.56 mg/L** measured in **water fluoride**, is an appropriate exposure level to use in this risk evaluation.

c. *Underlying findings*

89. Two studies are highly probative in assessing exposure levels in this risk evaluation: Till (2018), and Malin (2023). To summarize these studies:

a. Till (2018) studied samples collected from the MIREC Cohort (1,566 pregnant women in Canada) to assess the relationship between maternal urinary fluoride in pregnant women and water fluoride concentrations and concluded that "[c]ommunity water fluoridation is a major source of fluoride exposure" for the pregnant women studied. Dkt. No. 432-4, Trial Ex. 108 at 1. Specifically, the study observed that the mean urinary fluoride values were almost two times higher for pregnant women living in fluoridated regions compared to non-fluoridated regions, and "significantly lower" for women living in non-fluoridated regions. *Id.* at 6. The median concentration of fluoride in drinking water in Canada was 0.56 mg/L in fluoridated areas. *Id.* at 8 (Table 2). Given that the United States fluoridates its water levels at an optimal 0.7 mg/L (higher than the median in Till (2018)), the urinary fluoride levels in this sample are lower, if anything, relative to the condition of use at issue (fluoridation at 0.7 mg/L). The findings of Till (2018),

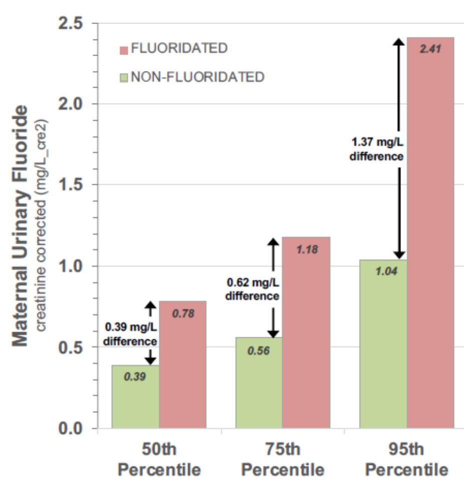
[27] The 95th percentile reflects individuals that have exposure levels greater than 95 percent of the population. *See* Dkt. No. 108 at 6. The median, on the other hand, reflects individuals at the mid-point of exposure. *See id.*

comparing the maternal urinary fluoride levels of pregnant women in fluoridated compared to non-fluoridated reasons are exemplified in the below tables, summarizing the key results of this study:

Table S4. Fluoride concentrations in the urine of pregnant women from the MIREC cohort living in fluoridated versus non-fluoridated communities.

	Trimester	N	Arith Mean	Arith SD	Geo Mean	Geo SD	Min	5%	25%	50%	75%	95%	Max
NON-FLUORIDATED													
MUF_Unadjusted	1	541	0.24	0.29	0.15	2.65	0.01	0.03	0.08	0.15	0.30	0.69	3.56
	2	509	0.32	0.33	0.23	2.22	0.03	0.06	0.13	0.22	0.38	0.90	3.54
	3	476	0.47	0.39	0.36	2.05	0.04	0.11	0.22	0.36	0.60	1.23	3.77
MUF_{SG}	1	541	0.31	0.39	0.20	2.56	0.01	0.04	0.12	0.20	0.35	0.84	4.67
	2	507	0.39	0.32	0.31	1.89	0.04	0.12	0.21	0.29	0.46	0.96	2.44
	3	475	0.48	0.32	0.40	1.78	0.08	0.17	0.28	0.38	0.56	1.09	2.71
MUF_{CRE_1}	1	533	0.50	0.50	0.35	2.40	0.01	0.08	0.22	0.37	0.60	1.41	4.5
	2	502	0.58	0.44	0.48	1.85	0.06	0.19	0.31	0.46	0.69	1.47	3.31
	3^a	386	0.67	0.47	0.56	1.75	0.12	0.24	0.40	0.54	0.79	1.45	4.61
MUF_{CRE_2}	1	534	0.41	0.45	0.29	2.42	0.01	0.06	0.18	0.30	0.49	1.15	4.81
	2	502	0.43	0.32	0.35	1.85	0.04	0.14	0.23	0.34	0.51	1.08	2.43
	3^a	386	0.48	0.33	0.40	1.75	0.08	0.17	0.29	0.39	0.56	1.04	3.29
FLUORIDATED													
MUF_Unadjusted	1	762	0.57	0.49	0.40	2.57	0.02	0.06	0.23	0.43	0.79	1.48	3.98
	2	728	0.71	0.53	0.56	2.03	0.04	0.17	0.35	0.56	0.89	1.68	3.77
	3	712	0.82	0.60	0.63	2.04	0.11	0.19	0.39	0.64	1.06	1.99	4.36
MUF_{SG}	1	762	0.52	0.46	0.37	2.44	0.01	0.07	0.25	0.4	0.64	1.30	3.84
	2	728	0.71	0.47	0.59	1.84	0.03	0.23	0.40	0.58	0.87	1.63	3.78
	3	711	0.88	0.55	0.74	1.81	0.08	0.27	0.51	0.77	1.08	1.89	3.97
MUF_{CRE_1}	1	757	0.83	0.68	0.60	2.44	0.01	0.12	0.39	0.65	1.09	2.19	4.89
	2	723	1.13	0.77	0.93	1.91	0.05	0.32	0.61	0.91	1.42	2.63	4.89
	3^a	546	1.30	0.82	1.10	1.86	0.12	0.41	0.72	1.08	1.63	3.10	4.63
MUF_{CRE_2}	1	759	0.68	0.58	0.49	2.46	0.01	0.09	0.31	0.53	0.88	1.80	4.61
	2	727	0.85	0.60	0.69	1.92	0.04	0.24	0.45	0.67	1.05	2.00	4.66
	3^a	553	0.97	0.68	0.80	1.90	0.09	0.29	0.52	0.78	1.18	2.41	4.78

Id. at 25 (Table S4) (red annotations added). This data is reflected in the below bar graph, illustrating that Till (2018) found that fluoride levels were approximately two times higher in fluoridated vs. non-fluoridated areas:[28]



[28] Though not in evidence, the Court includes this demonstrative bar graph (presented to the Court

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b. Malin (2023) studied the maternal urinary fluoride levels of pregnant women in Los Angeles, California (*i.e.*, samples collected from the Maternal and Developmental Risks from Environmental and Social Stressors cohort ("MADRES Cohort")) to discern if those levels of American women were comparable to levels observed amongst pregnant women in Mexico and fluoridated communities in Canada. Dkt. No. 432-18, Trial Ex. 122 at 9. Malin (2023) concluded that the maternal urinary levels observed in Los Angeles were comparable to those found in pregnant women in Mexico and Canada. *Id.* at 1, 9. These findings corroborate the conclusions of Till (2018), and further support that water intake is an important contributor to maternal urinary fluoride levels.

90. Plaintiffs have shown, by a preponderance of the evidence, that a pregnant mother in the United States, under the condition of use (community water fluoridation of 0.7 mg/L, which is higher than the median water fluoridation levels in the Till (2018) data set of 0.56 mg/L found in Canada) produces a maternal urinary fluoride concentration level of at least **0.8 mg/L** for median water consumption or **1.89 mg/L** for 95th percentile water consumption.

a. As explained above, Till (2018) studied urinary fluoride levels in fluoridated areas of Canada, and identified a median (specific gravity adjusted) urinary fluoride level of 0.77 mg/L and a 95th percentile urinary fluoride level of 1.89 mg/L. Dkt. No. 432-4, Trial Ex. 108 at 25-26 (Table S4); Dkt. No. 395, Jan. 31, 2024, Trial Tr. at 118:5-20 (Hu). Malin (2023) studied pregnant mothers living in Los Angeles, California, a fluoridated city, and similarly observed that those mothers had a median (specific gravity-adjusted) urinary fluoride level of 0.8 mg/L, and a 95th percentile level of 1.89 mg/L, in the third trimester. Dkt. No. 432-18, Trial Ex. 122 at 5 (Table 2); Dkt. No. 395, Jan. 31, 2024, Trial Tr. at 124:1-16 (Hu). Dr. Hu testified credibly that the Malin (2023) cohort is representative of mothers in the United States as a whole, though if anything, this cohort would present *lower* fluoride exposure levels relative to other populations because data indicates Hispanic communities have a greater distrust of tap water relative to other communities, in part due to immigration from Mexico where tap water is distrusted. Dkt. No. 395,

as Plaintiff's Demonstrative No. 4 at trial) to illustrate fully the trial testimony.

Jan. 31, 2024, Trial Tr. at 118:11-119:9 (Hu). Canada and the United States each take a similar approach to water fluoridation; both countries identify 0.7 mg/L as the optimal fluoridation level. *See* NTP Monograph at 1; Dkt. No. 396, Feb. 1, 2024, Trial Tr. at 245:1-22 (Lanphear). It follows that pregnant woman in the United States, exposed to fluoride under the condition of use at issue (community water fluoridation at a typical or optimal level of 0.7 mg/L) have an exposure level of **0.8 mg/L measured in maternal urinary fluoride** (median water intake) and **1.89 mg/L measured in maternal urinary fluoride** (95th percentile water intake), urinary fluoride levels that reflect the real world results of drinking water fluoride levels at the condition of use at issue in this case.

b. To be sure, maternal urinary fluoride reflects not only fluoride that a pregnant woman is exposed to from drinking fluoridated water from her community (the condition of use at issue), but also fluoride from other sources such as food and beverage and household items such as toothpaste; it reflects aggregate exposure to fluoride. *See* Dkt. No. 395, Jan 31, 2024, Trial Tr. at 105:10-25 (Hu); Dkt. No. 416, Feb. 12, 2024, Trial Tr. at 1404:19-21 (Barone); Dkt. No. 198-1 (Hu Trial Decl.). The EPA argues that because maternal urinary fluoride reflects *aggregate* fluoride exposure, rather than exposure attributed solely from community water fluoridation, maternal urinary fluoride is an inappropriate metric to use in assessing the risk of community water fluoridation. However, exposure level of fluoride expressed in the metric of maternal urinary fluoride is properly used in this risk assessment because:

i. Maternal urinary fluoride, though not a perfect metric in all respects, is a valuable metric in assessing risk associated with water fluoridation since it is a comprehensive metric, reflecting the true aggregate exposure to the chemical at issue. As Dr. Hu explained: "[T]he primary benefit [of using urinary fluoride as the metric of fluoride exposure] is that you're integrating fluoride exposure from whatever exposure source there is. So if it's dietary, if it's in the water, it's in the food, it's in the food that was cooked with the fluoridated water; if you happen to swallow toothpaste or if you're using other sources of fluoride, it will integrate all of it and express it in terms of what is the level of fluoride that's circulating in your blood and then gets filtered out into the kidneys. And that ultimately is the component of fluoride in the body that's

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available to cross the blood-brain barrier to the brain and also to go to other target organs in the body." Dkt. No. 395, Jan. 31, 2024, Trial Tr. at 105:13-25 (Hu). Put differently, this metric reflects that water fluoridation does not occur in a vacuum; in the real world, fluoridating water means exposing women to fluoride *in addition to* the exposure a woman has to fluoride via other sources. Because dosage matters, it makes good sense to consider other sources of exposure to fluoride in deciding if adding to that exposure level presents a risk. *See* Dkt No. 400, Feb. 5, 2024, Trial Tr. at 676:12-21 (Barone) (recognizing that exposure and point of departure can be expressed in urine content in a risk assessment); Dkt. No. 402, Feb. 8, 2024, Trial Tr. at 1015:9-1020:13 (Savitz) (discussing pros and cons of using urinary fluoride as a measurement of water fluoridation and recognizing that urinary fluoride has a "number of positive features," including integrating exposure from different sources, that it is a measurement reflecting not just what is in that body on a given day but for a longer period of time, and explaining that he has used urinary fluoride as a metric in assessing another chemical, PFAS); Dkt. No. 401, Feb. 6, 2024, Trial Tr. at 790:8-12 (Thiessen) ("there's no scientific reason why [the exposure level and hazard level] have to be milligrams per kilogram per day. They could also be milligrams per liter in the drinking water, they could also be milligrams per liter *in the urine*") (emphasis added).

ii. The EPA permits considering the *additive* risk posed by a chemical under the condition of use at issue when conducting a risk evaluation. To this end, Dr. Barone explained that in a situation where the condition of use is additive to other background sources, "you want to be able to understand, well, what's the background, be able to subtract the background; you want to be able to say what's the dietary component and what is the actual water intake component. And then if you have information on the other sources, potential sources, whether it's pharmaceutics or other inhaled or overly ingested pollutants having a similar kind of exposure, additive exposures, *you want to be able to capture that to the best of your ability*." Dkt. No. 400, Feb. 5, 2024, Trial Tr. at 678:6-21 (Barone) (emphasis added). *See also* Dkt. No. 400, Feb. 5, 2024, Trial Tr. (Barone) at 567:18-568:2 ("Q. And the point of the exposure assessment is to identify what the human exposure level is under the specific conditions of use of the chemical being evaluated, right? A. It is – it is condition-of-use specific. Q. Now, it is condition-of-use specific, but TSCA specifically permits EPA to consider aggregate exposures to the chemical, correct? A. *TSCA specifically allows for consideration of aggregate exposures*. It doesn't require us to quantify based upon aggregate exposures") (emphasis added). Indeed, rather than preventing a risk evaluator from considering aggregate exposure to a chemical in evaluating risk, Amended TSCA expressly identifies that a risk evaluator should describe whether *aggregate exposure* was considered and explain why, or why not. *See* 15 U.S.C. § 2605(b)(4)(F). Specifically, the statute provides: "[i]n conducting a risk evaluation under this subsection, the Administrator shall . . . describe *whether aggregate or sentinel exposures to a chemical substance under the conditions of use were considered*, and the basis for that consideration." 15 U.S.C. § 2605(b)(4)(F) (emphasis added).

iii. If water fluoridation was a minor contributor to overall exposure to fluoride, then it may be less appropriate to utilize an aggregate exposure metric in assessing risk of water fluoridation. If that were the case, much of the risk at issue would not derive from water fluoridation but another source; regulating water fluoridation would be of little consequence to the total exposure. But that is not the case. Instead, as described in depth below at ¶ 91(a), water fluoridation accounts for more than half of a pregnant woman's aggregate exposure level (*i.e.*, maternal urinary fluoride level). To this end, Dr. Thiessen credibly testified that fluoride content of the urine "will be driven by the fluoride content of the water," as "for most individuals, the intake is driven by the fluoridated water." Dkt. No. 402, Feb. 8, 2024, Trial Tr. at 934:18-22 (Thiessen). Drinking water fluoridation is highly consequential to a pregnant woman's overall exposure level and so it is wholly appropriate to use maternal urinary fluoride as the metric of exposure in assessing the risk of community water fluoridation. *See also* Dkt. No. 401, Feb. 6, 2024, Trial Tr. at 790:8-12 (Thiessen) ("[T]here's a consistent association between urinary fluoride and drinking water fluoride concentrations. As the concentration of fluoride in the drinking water increases, the fluoride concentration in the urine will increase."), 792:19-2793:16 ("[I]n most cases, the primary driver of the total fluoride intake [is fluoride concentration in the drinking water]. So you can still make that hazard-to-exposure comparison.”).[29]

91. To the extent that risk assessment requires determining the exposure level attributed solely to the condition of use (community water fluoridation), Plaintiffs have shown, by a preponderance of the evidence, that at least half of the maternal urinary fluoride levels observed, **0.4 mg/L** (median) (*i.e.*, 0.8 mg/L divided by two) maternal urinary fluoride and **0.945** mg/L (95th percentile) (*i.e.*, 1.89 mg/L divided by two) maternal urinary fluoride can be attributed to the condition of use (community water fluoridation):

a. As explained above, ¶ 89(a), Till (2018) observed that the maternal urinary fluoride levels were approximately **two-times higher** for pregnant women living in fluoridated regions compared to non-fluoridated regions. Dkt. No. 432-4, Trial Ex. 108 at 6, 25-26 (Table S4). Dr. Thiessen credibly testified that it is reasonable to conclude from Till (2018) that the 2x increase in maternal urinary fluoride levels in fluoridated areas can be attributed to community water fluoridation in those areas. *See* Dkt. 401, Feb. 6, 2024, Trial Tr. at 784:1-16 (Thiessen) (“The primary difference and the only main group difference that we’re aware of is that one group is fluoridated and one is not. So a difference in the urinary fluoride would be attributable to the fluoride in the drinking water.”); Dkt. No. 402, Feb. 8, 2024, Trial Tr. at 934:18-22 (Thiessen). And the EPA’s expert witness agreed that the increase in maternal urinary fluoride levels can largely be attributed to intake of fluoridated water. Dkt. No. 416, Feb. 13, 2024, Trial Tr. at 1408:10-1409:11 (Barone) (explaining that the “parsimonious” explanation as to the 2x increase of maternal urinary fluoride levels observed in Till (2018) is that it is “due to intake, total intake,

[29] In Thippeswamy (2021), the researchers compared fluoride concentrations in urine, serum, and cord blood of women consuming water with designated “low” and “optimum” concentrations of fluoride to understand the relationship of these metrics. Dkt. No. 432-7, Trial Ex. 111 at 1. Thippeswamy (2021) did not observe a one-to-one correlation between urinary fluoride and water fluoride concentration, but concluded that “the low/optimum fluoride concentration in drinking water compared to urine . . . correlated significantly.” *Id.* The strong relationship between the fluoride concentration in water and urinary fluoride is further corroborated by Green (2019). Green (2019) studied samples collected from the MIREC Cohort (Canadian women and offspring) and identified a moderate correlation between maternal urinary fluoride intake and water fluoride concentration. Dkt. No. 432-5, Trial Ex. 109 at 1, 5 (“The MUF, was moderately correlated with fluoride intake ($r = 0.49$; $P < .001$) and water fluoride concentration ($r = 0.37$; $P < .001$).”). Though not a one-to-one comparison, the correlation observed in these studies further corroborates Dr. Thiessen’s testimony as to the relationship between water fluoride and urinary fluoride.

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and that's probably both food and water . . . [a]nd water is a significant portion . . . of that"). Moreover, water fluoridation also contributes to fluoride exposure indirectly because commercial food and beverages are made using fluoridated water; this is known in the scientific community as the "halo effect" of water fluoridation. *See, e.g.*, Dkt. No. 401, Feb. 6, 2024, Trial Tr. at 799:7:800:13 (Thiessen) (describing the "halo effect" of water fluoridation wherein individuals ingest water that has been fluoridated by way of beverages such as colas, juices, beer and wine, that were made using water from a fluoridated community); Dkt. No. 396, Feb. 1, 2024, Trial Tr. at 212:7-23 (Lanphear) (describing the "halo effect" of communities that fluoridate water, causing exposure of fluoride in surrounding areas by way of food and beverage). *See also* Dkt. No. 432-4, Trial Ex. 108 at 6-7 (describing the "diffusion or halo effect" . . . "which refers to the extension of fluoridation to residents of nonfluoridated communities as a result of foods and beverages that are commercially processed in fluoridated areas and consumed in nonfluoridated communities") (citing Griffin et al. 2001; Ripa 1993). Accordingly, it is appropriate to infer conservatively that approximately **half** of the maternal urinary fluoride observed in a pregnant woman's urine is attributed to community water fluoridation.[30] Here, that is **0.4 mg/L** (0.8 mg/L divided by two) (median) maternal urinary fluoride and **0.945 mg/L** (1.89 mg/L divided by two) (95th percentile) maternal urinary fluoride.

b. One concern regarding extrapolating water intake from maternal urinary fluoride is that fluoride intake is not necessarily equivalent with fluoride excretion; the absorption and excretion process adds complexity. For example, a pregnant woman will experience the breakdown of her own skeleton during pregnancy to form the fetal skeleton, releasing fluoride absorbed in her bones, resulting in an increase in excretion of urine not tied to additional fluoride consumption. *See* Dkt. No. 395, Jan. 1, 2024, Trial Tr. at 121:10-20 (Hu). To this end the EPA argues that because of the complexities regarding absorption and excretion of fluoride, use of a physiologically based pharmacokinetic ("PBPK") modeling[31] is necessary to convert maternal

[30] As noted below in Paragraph 91(b)(i), the EPA allows for assumptions, including, *e.g.*, absorption rates, when specific data is not available.

[31] PBPK model is "a computer model that estimates concentrations of a substance in other parts of

urinary fluoride levels to estimate the fluoride intake level. Because Plaintiffs have not done PBPK modeling, EPA argues, it is inappropriate to estimate exposure attributed to the condition of use from maternal urinary fluoride. *See* Dkt. No. 402, Feb. 8, 2024, Trial Tr. at 943:1-7 (Thiessen) (recognizing that PBPK models have not been identified to predict maternal urinary fluoride concentrations based on drinking water exposures.). The Court rejects the EPA's argument for the following reasons.

i. While PBPK modeling may be useful and perhaps ideal, it is not essential to conduct a risk evaluation. The Amended TSCA does not expressly mandate use of a PBPK model, but instead affords ample discretion in the methodologies and modeling the risk assessor may employ in assessing risk. *See* 15 U.S.C. § 2625(h) (describing factors to be considered determining the methodologies or models to employ when assessing risk and omitting any reference to a PBPK model).[32] And the EPA Guidelines expressly recognize that pharmacokinetic data may not always be available and instructs a risk assessor to be aware of

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the body based on physiological parameters like absorption" and is used to convert from excretion level to intake level. *See* Dkt. No. 402, Feb. 8, 2024, Trial Tr. at 943:1-7 (Thiessen).

[32] This section provides in full:

> In carrying out sections 2603, 2604, and 2605 of this title, to the extent that the Administrator makes a decision based on science, the Administrator shall use scientific information, technical procedures, measures, methods, protocols, methodologies, or models, employed in a manner consistent with the best available science, and shall consider as applicable – (1) the extent to which the scientific information, technical procedures, measures, methods, protocols, methodologies, or models employed to generate the information are reasonable for and consistent with the intended use of the information; (2) the extent to which the information is relevant for the Administrator's use in making a decision about a chemical substance or mixture; (3) the degree of clarity and completeness with which the data, assumptions, methods, quality assurance, and analyses employed to generate the information are documented; (4) the extent to which the variability and uncertainty in the information, or in the procedures, measures, methods, protocols, methodologies, or models, are evaluated and characterized; and (5) the extent of independent verification or peer review of the information or of the procedures, measures, methods, protocols, methodologies, or models.

15 U.S.C. § 2625(h).

uncertainties posed by lack of such data. Specifically, the EPA Guidelines provide: "If data to be used in a risk characterization are from a route of exposure other than the expected human exposure, then pharmacokinetic data should be used, if available, to make extrapolations across routes of exposure. If such data are not available, the Agency makes certain assumptions concerning the amount of absorption likely or the applicability of the data from one route to another (U.S. EPA, 1992)." EPA Guidelines at 62. This is an implicit recognition that a risk evaluation can proceed without pharmacokinetic modeling when such data is not available. *See also* EPA Guidelines at 47 ("Pharmacokinetic data *may* be helpful in defining the dose-response curve, developing a more accurate basis for comparing species sensitivity (including that of humans), determining dosimetry at sites, and comparing pharmacokinetic profiles for various dosing regimens or routes of administration. The correlation of pharmacokinetic parameters and neurotoxicity data *may* be useful in determining the contribution of specific pharmacokinetic processes to the effects observed.") (emphasis added). Dr. Barone likewise testified that the EPA has conducted risk evaluations under Amended TSCA without PBPK modeling as such models are not always available, explaining: "[w]e used PBPK models in five of the first [ten] risk evaluations. And to varying degrees . . . In some cases we actually had the ability to . . . incorporate studies that included oral exposures, inhalation exposures and dermal exposures . . . so we could look at a wider range of exposures and to do that aggregation of exposures across routes. That's not always available to us, we don't always have those kinds of models available to us." Dkt. No. 400, Feb. 5, 2024, Trial Tr. at 675:9-676:7 (Barone). *See also* Dkt. No. 401, Feb. 6, 2024, Trial Tr. at 576:12-17 (Barone), 578:8-10 (Barone) ("Q. And in EPA's 10 risk evaluations under TSCA, EPA has only departed from using the default uncertainty factor of 10 for intraspecies variability when it had an acceptable physiologically-based pharmacokinetic model for the chemical, correct? A. In the first ten that is a true statement."). Put simply, this lack of PBPK modeling is not fatal to Plaintiffs' proof.

ii. Though Plaintiffs do not present a PBPK model, Till (2018) and Malin (2023) provide real-world, observational data as to the exposure level of for the population at issue under the condition of use at issue. *See* ¶ 90. *See also* Dkt. No. 400, Feb. 5, 2024, Trial

Tr. at 678:6-21 (Barone) (describing that in assessing risk under a condition of use one endeavors to subtract the background exposure from the water intake component to understand the risk at issue, ideally through modeling, but ultimately "to the best of your ability"). And uncertainties posed by lack of modeling may be accounted for in subsequent steps of the analysis (*i.e.*, assessing overall confidence in data in the risk characterization, *see* ¶¶ 112-13 and when determining the appropriate uncertainty factor to employ when assessing the margin of exposure, *see* ¶ 101(b)). Under the present circumstances, there is sufficient data to support the exposure levels identifies notwithstanding lack of PBPK modeling.[33]

iii. As stated above, Till (2018) observed an approximately 2x increase in maternal urinary fluoride levels comparing the mothers in fluoridated relative to non-fluoridated communities across three trimesters of pregnancy. *See* Trial Ex. 108, Dkt. No. 432-4 at 6-7, 8-9; Dkt. No. 432-18, Trial Ex. 122 at 5-6 (Table 2 and Fig. 1). However, Till (2018) and Malin (2023) also observed that pregnant women's maternal urinary fluoride levels increased in *both* fluoridated and non-fluoridated areas in the third trimester of pregnancy relative to the first trimester. *See* Dkt. No. 432-4, Trial Ex. 108 at 8-9, Table 3; Dkt. No. 432-18, Trial Ex. 122, at 5-6 (Table 2 and Fig. 1). This would, at first blush, suggest that something other than fluoridated water contributed to increased maternal urinary fluoride levels in the third trimester, undermining the assumption that fluoridated water is a significant contributor to those levels. However, this observation is well accounted for. As explained previously, the increase in maternal urinary fluoride across both populations in the third trimester of pregnancy is believed to be caused by the breakdown of the maternal skeleton in later trimesters of pregnancy to facilitate the formation of the fetal bone – a process that releases fluoride. *See, e.g.*, Dkt. No. 395, Jan. 1, 2024, Trial Tr. at 121:10-20, 121:25-123:8 (Hu). This observation thus does not undermine the probative value of

[33] Though EPA does not bear the burden of proof in this context the Court does note that EPA has not explained why, if PBPK modeling is necessary to understand risk associated with water fluoridation and appropriate models are available, the EPA has not itself conducted this PBPK modeling. This is not legally relevant given the statutory framework, and does not bear on the Court's findings. However, to the extent that the EPA determines that PBPK modeling is necessary to engage in rulemaking, it may conduct this assessment to put a finer point on risk posed by the condition of use before taking regulatory action; there is nothing preventing EPA from doing so.

Till (2018) and Malin (2023).

92. The present recommended water fluoride concentration in the United States is 0.7 mg/L fluoride. NTP Monograph at 1. It follows that pregnant women living in a fluoridated community in the United States are typically exposed to fluoride levels of **0.7 mg/L** fluoride, measured in water fluoridation. Even more conservatively, the Till (2018) median water fluoride level of **0.56 mg/L** measured in water fluoride is also an appropriate, conservative exposure level to utilize in the risk evaluation. This is because the United States and Canada (where data for Till (2018) was collected) take a similar approach to water fluoridation. *See* Dkt. No. 433-4, Trial Ex. 129 at 16 (describing optimal water fluoride levels in Canada of 0.7 mg/L); Dkt. No. 396, Feb. 1, 2024 Trial Tr. at 245:1-22 (Lanphear) (describing optimal 0.7 mg/L water fluoride standard in Canada). Moreover, urinary fluoride levels in mothers from Los Angeles observed in Malin (2023) and Till (2018) are highly similar. *See* Dkt. No. 432-18, Trial Ex. 122 at 1, 9.

93. The EPA often expresses exposure and hazard level in mg/kg/day, but this is not necessary. What is vital, however, is that the exposure level and hazard level is in the same unit. Dkt. No. 400, Feb. 5, 2024, Trial Tr. (Barone) at 672:22-673:4 (testifying that what matters is that the "[e]xposure concentration in the denominator has to be in the same units as the hazard point of departure or hazard level in the numerator[;] [t]hey have to match up"). Dr. Thiessen likewise testified that "there's no scientific reason why [the hazard and exposure levels] have to be milligrams per kilogram per day. They could also be milligrams per liter in the drinking water, they could also be milligrams per liter in the urine. What matters is comparison of a hazard level and exposure level that are in the same units." Dkt. No. 401, Feb. 6, 2024, Trial Tr. at 790:18-791:16 (Thiessen). Thus, the exposure and hazard level need not be expressed in mg/kg/day, but the units for each must match when conducting subsequent steps of the analysis.

94. For the reasons stated above, and in view of the record evidence, Plaintiffs have shown by a preponderance of the evidence that:

a. Pregnant mothers in fluoridated communities in the United States are typically exposed to fluoridation of drinking water at a concentration level of **0.7 mg/L**, or conservatively, **0.56 mg/L**. They have a median exposure level to fluoride of **0.8 mg/L** (measured in maternal urinary fluoride), and at the 95th percentile have an exposure level to fluoride of **1.89 mg/L** (measured in maternal urinary fluoride).

b. To the extent that the exposure level used in this risk assessment must reflect exposure attributed solely to the condition of use of the chemical, approximately half of the maternal urinary fluoride levels discussed in Paragraph 87 are attributed to water fluoridation.

C. Step 3: Risk Characterization

a. *Framework*

95. At this step, the EPA calculates the risk presented by the chemical at issue by comparing the point of departure (*i.e.*, hazard level) with the human exposure level. *See* Dkt. No. 401, Feb. 6, 2024, Trial Tr. at 705:7-706:21 (Barone). To ensure a risk is not present, the EPA utilizes a Margin of Exposure (MOE) equation that compares a safe margin from the point of departure (benchmark MOE) with the actual margin between the exposure level and point of departure (MOE). *See id.* at 707:13-708:19.

96. The actual MOE is calculated by discerning the ratio of the point of departure and the human exposure level, *i.e.*, the point of departure divided by the exposure level. Dkt. No. 429-7, Trial Ex. 17 at 65. The benchmark MOE (*i.e.*, the safe or requisite margin) is the product of the applicable uncertainty factors (UFs) (*i.e.*, UF x UF). *See id.* at 2-3; Dkt. No. 400, Feb. 5, 2024, Trial Tr. at 575:17-576:24 (Barone), 580:10-13 (Barone) ("Q. Now, the benchmark MOE is the product of all uncertainty factors that are found to be applicable to a given – to a given hazard, correct? A. To a given hazard, that's correct."), 580:24-581:19 (Barone) ("We don't add them. We multiply – if the uncertainty factor is the default of 10 for human variability, then we use that and multiply is by any other uncertainty factors."). For example, if there is an uncertainty factor of 10 for intraspecies variability, and an uncertainty factor of 10 for using a LOAEL as the point of departure, the benchmark MOE is 100 (10 times 10). *Id.* at 581:12-582:11. As another example, if the first uncertainty factor is 10, and the second uncertainty factor is 3, the benchmark MOE is 30 (10 times 3). *Id.*

97. If the actual MOE is lesser (*i.e.*, there is a smaller margin) than the benchmark MOE, then there is a risk present; if the actual MOE is greater (*i.e.*, there is a bigger margin) than the

benchmark MOE then a risk is presumed not to be present. *See* Dkt. No. 400, Feb. 5, 2024, Trial Tr. at 583:8-13 (Barone) (explaining that if the benchmark MOE exceeds the MOE between the hazard and exposure level a risk is present); Dkt. No. 401, Feb. 6, 2024, Trial Tr. at 707:20-708:9 (Barone) (explaining the converse).

b. *Key findings*

98. A risk is present when using the BMCL of 0.28 mg/L (maternal urinary fluoride) as the point of departure, and whether calculating risk using either the median or high-end exposure levels; the exposure levels exceed the point of departure.

99. A risk is present when using the BMCL of 0.768 mg/L or even 1.536 mg/L (maternal urinary fluoride) as the point of departure, whether calculating risk using either the median or high-end exposure levels; the exposure levels exceed the point of departure.

100. Alternatively, a risk is present when utilizing the conservative 4 mg/L (water fluoride) as the point of departure; the actual MOE is less than the benchmark MOE.

c. *Underlying findings*

(a) BMCL: 0.28 mg/L and in the alternative, 0.768 mg/L and/or 1.536 mg/L (maternal urinary fluoride)

101. The appropriate benchmark MOE to use in calculating risk for the BMCLs identified by Dr. Grandjean is 10, which includes at least one UF of 10 to account for intraspecies variability:

a. A UF of 10 is utilized as a default practice in calculating risk to account for intraspecies variability, *i.e.*, the variability within the human species in reacting to chemicals.[34] *See* Dkt. No. 401, Feb. 6, 2024, Trial Tr. at 712:12-713:22 (Barone).

b. Absent use of physiologically based pharmacokinetic (PBPK) modeling to account for those variabilities, which could allow for the reduction of the UF from 10 down to 3, the EPA applies the UF of 10 in calculating the benchmark MOE. *See id.* at 712:24-713:22; Dkt. No. 401,

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[34] Intraspecies variability can be compared with interspecies variability, which accounts for variability between different species (*i.e.*, animals and humans) when extrapolating from animal studies. Dkt. No. 401, Feb. 6, 2024, Trial Tr. at 713:6-10 (Barone).

Feb. 6, 2024, Trial Tr. at 576:12-17 (Barone), 578:8-10 (Barone) ("Q. So the default uncertainty factor that EPA uses to account for intraspecies variability and uncertainty is 10, correct? A. That is the default. Q. And in EPA's 10 risk evaluations under TSCA, EPA has only departed from using the default uncertainty factor of 10 for intraspecies variability when it had an acceptable physiologically-based pharmacokinetic model for the chemical, correct? A. In the first ten that is a true statement.").

c. A PBPK model has not been performed to assess fluoride intake in pregnant women. Dkt. No. 402, Feb. 8, 2024, Trial Tr. at 943:1-16 (Thiessen); Dkt. No. 440, Feb. 13, 2024, Trial Tr. at 1396:17-1397:2 (Barone), 1397:20-23 (Barone) ("Q. And so in the nearly four years since the first trial in this case, plaintiffs still have not performed a PBPK model to extract a urinary fluoride value to an intake value, right? A. No, they haven't.").

d. Because there is no PBPK model utilized here, which would decrease uncertainty and allow from a downward departure of the default UF of 10, the default UF of 10 is appropriately used as the benchmark MOE in the present risk evaluation.

102. The median exposure level for pregnant women measured in urinary fluoride is 0.8 mg/L, and the 95th percentile is 1.89 mg/L. *See* ¶ 87.

103. The actual MOE for the BMCL of 0.28 mg/L at the median exposure level is 0.35 (0.28 mg/L divided by 0.8 mg/L) and 0.148 at the 95th percentile exposure level (0.28 mg/L divided by 1.89 mg/L). The actual MOEs, 0.35 and 0.148, do not exceed the benchmark MOE of 10; thus, the MOE is below the benchmark MOE and a risk is present. *See* Dkt. No. 401, Feb. 6, 2024, Trial Tr. at 707:20-708:9 (Barone) (explaining that a risk is not present where the actual MOE is *higher* than the benchmark MOE). Another way of looking at exposure/risk is taking the BMCL and adjusting it downward for risk factors. To account for a ten-fold risk factor of human variability, actual exposure should not exceed 1/10th of the BMCL of 0.28 mg/L – *i.e.*, 0.028 mg/L. However, the trial evidence establishes actual exposure of levels of 0.8 and 1.89 mg/L – this far exceeds that safety limit of 0.028 mg/L. *See also* Dkt. No. 198-4 at 75-77 (Thiessen Decl.) (providing MOE calculations).

104. The actual MOE for the BMCL of 0.768 mg/L at the median exposure level is 0.96

(0.768 mg/L divided by 0.8 mg/L) and 0.406 at the 95th percentile exposure level (0.768 mg/L divided by 1.89 mg/L). The actual MOEs, 0.96 and 0.406, do not exceed the benchmark MOE of 10; thus, the MOE is below the benchmark MOE and a risk is present. *See* Dkt. No. 401, Feb. 6, 2024, Trial Tr. at 707:20-708:9 (Barone). *See also* Dkt. No. 198-4 at 75-77 (Thiessen Decl.) (providing MOE calculations). Put differently, 1/10th of this BMCL is 0.0768 mg/L (0.768 mg/L divided by 10). Both the median and upper exposure levels of fluoride found in mothers' urine exceed this amount.

105. Even using the higher 1.536 mg/L BMCL to account for omission of the OCC Cohort data, *see* ¶ 73 (discussing exclusion of OCC Cohort data in deriving 0.768 mg/L BMCL using squared model in Grandjean (2022)), a risk is present. Using this figure, the actual MOE at the median exposure level is 1.92 (1.536 mg/L divided by 0.8 mg/L) and 0.813 at the 95th percentile exposure level (1.536 mg/L divided by 1.89 mg/L). 1.92 and 0.813 do not exceed 10; thus, the actual MOE is below the benchmark MOE and a risk is present. *See* Dkt. No. 401, Feb. 6, 2024, Trial Tr. at 707:20-708:9 (Barone). *See also* Dkt. No. 198-4 at 75-77 (Thiessen Decl.) (providing MOE calculations). Put differently, 1/10th of this BMCL is 0.1536 mg/L (1.536 mg/L divided by 10). Both the median and upper exposure levels in mothers' urine exceed this amount.

106. Even if the Court were to consider only half of the exposure level, directly attributable to water fluoridation, as opposed to other sources of fluoride (0.4 mg/L (0.8 mg/L divided by 2) (median) maternal urinary fluoride and 0.945 mg/L (1.89 mg/L divided by 2) (95th percentile) maternal urinary fluoride, a risk is still present. Both of these figures exceed the safe level using a BMCL of 0.28 mg/L (0.028 mg/L). *See* ¶ 103. And these figures also exceed the safe level considering the margin of error if the BMCL of 0.768 mg/L or 1.536 mg/L; the safe levels are 0.0768 mg/L and 0.1536 mg/L (1/10th of each BMCL), respectively. *See* ¶¶ 104-05.

(b) <u>LOAL: 4 mg/L (water fluoride)</u>

107. Alternatively, to the extent that the BMCLs identified previously are not appropriate points of departure, or maternal urinary fluoride is not an appropriate metric, a risk is present using a LOAL of 4 mg/L measured in water fluoride.

108. The appropriate UF applied in the benchmark MOE analysis using the LOAEL of 4

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mg/L is 100 (10 x 10):

a. The UF of 10 is appropriately applied to account for intraspecies variability. *See* ¶ 101.

b. A second UF of 10 is also appropriately applied when using a LOAEL as the point of departure. Dkt. No. 440, Feb. 13, 2024, Trial Tr. at 1425:13-17 (Barone) ("Q. Right. If we were using a human study and only had a LOAEL, like was the case with PCE, you would, at that point, consider an additional uncertainty factor beyond the intraspecies variability uncertainty factor? A. Generally, yes. Yes, we would.").

c. Again, the benchmark MOE is calculated by multiplying the applicable UFs. Dkt. No. 400, Feb. 5, 2024, Trial Tr. at 575:17-576:24 (Barone), 580:10-13 (Barone) (explaining that the benchmark MOE is the product of applicable UFs), 580:24-581:19 (stating that "[w]e don't add them[;] [w]e multiply").

109. Pregnant women in "optimally" fluoridated communities in the United States have an exposure level of at least 0.7 mg/L (water fluoride). *See* ¶ 86. Or conservatively, 0.56 mg/L derived from Till (2018), in the alternative. *See* ¶ 89(a).

110. The actual MOE for the LOAEL of 4 mg/L (water fluoride) is 5.71 (4 mg/L divided by 0.7 mg/L) or 7.14 (4 mg/L divided by 0.56 mg/L).

111. 5.71 and/or 7.14 do not exceed 100; the actual MOE is below the benchmark MOE and thus a risk is present. Dkt. No. 400, Feb. 5, 2024, Trial Tr. at 583:8-13 (Barone) (explaining that if the benchmark MOE exceeds the MOE between the hazard and exposure level a risk is present). *See also* Dkt. No. 198-4 at 75-77 (Thiessen Decl.) (providing MOE calculations). Again, another way of looking at this is to take the LOAEL of 4 mg/L, and divide that by the two risk factors. To this end, 4 mg/L divided by 100 equals 0.04 mg/L, reflecting the tolerable concentration of exposure given the risk factors. Exposure to 0.7 mg/L in United States drinking water, or conservatively 0.56 mg/L (Till (2018)),[35] far exceeds that limit.

[35] The condition of use at issue in this suit is fluoridation of water at 0.7 mg/L. However, it is useful to consider the risk posed with the lesser exposure level of 0.56 mg/L given the findings of Till (2018). There, subjects in Canada – which has the same optimal level of water fluoridation as the United States – had a median community water fluoride level of 0.56 mg/L. It follows that

D. Step 4: Risk Determination

a. *Framework*

112. Once the risk has been identified, in the last step of the risk evaluation process the assessor determines if that risk is an *unreasonable* one. Dkt. No. 401, Feb. 6, 2024, Trial Tr. at 735:11-19 (Barone).

113. In making the determination of whether the risk is unreasonable, the assessor considers several factors including: (1) severity of the hazard; (2) exposure-related considerations (*e.g.*, duration, magnitude, or frequency of the exposure, and size of the affected population); (3) other characteristics of the population that is exposed, including the susceptibility of subpopulations; (4) confidence in the information used to inform the hazard and exposure values; and relatedly, the (5) overall strength of the evidence and uncertainties and assumptions included throughout the risk assessment. *See* Dkt. No. 401, Feb. 6, 2024, Trial Tr. at 735:11-736:19 (Barone); Dkt No. 437-1, Trial Ex. 96, at 500 (PCE Risk Evaluation); Dkt. No. 437-3, Trial Ex. 98 at 271 (1,4-Dioxane Risk Evaluation).

b. *Key finding*

114. Based on the aforementioned factors, and in view of the record evidence, the risk at issue – reduced IQ in children posed by water fluoridation at 0.7 mg/L – is an unreasonable risk.

c. *Underlying findings*

115. Given the seriousness of reduced IQ, and the ample support in the record that the United States population is at risk of experiencing IQ decrements of over four IQ points, the **severity** of the hazard at issue (reduced IQ in children, *see* Section III.A.1.), weighs in favor of finding the risk at issue unreasonable:

a. The EPA has recognized that cognitive deficits including reduced IQ are critical chronic health effects, as exemplified by its in its risk evaluation of PCE under the Amended TSCA which identified cognitive deficits as the hazard warranting regulatory action. Dkt. No.

some communities in the United States may have similar median water fluoridation levels. Thus, it is worth considering if a risk is present at this lower level of exposure, to understand the risk of setting an optimal fluoridation level of 0.7 mg/L as is the standard in the United States.

400, Feb. 5, 2024, Trial Tr. at 597:9-13 (Barone). Moreover, according to the EPA's Clean Air Science Advisory Commission, in the context of its analysis of lead: "[a] population loss of 1-2 IQ points is highly significant from a public health perspective." Dkt. No. 430-1, Trial Ex. 42 at 67000. To this end, a 1-to-2 point loss in IQ was the hazard that supported the identification of lead as a substance posing an unreasonable risk. *Id.* *See also* Dkt. No. 433-4, Trial Ex. 129 at 27 (recognizing that one study found that a reduction of one IQ point "has been shown to be associated with reduced educational attainment, employment status, productivity, and earned wages, reflecting substantial public health concerns").

b. In risk assessments, the EPA evaluates not only the hazard presented at median exposures levels, but considered the hazard posed to the 95th percentile (*i.e.*, high exposure populations). Dkt. No. 430-1, Trial Ex. 42 at 67000. And the EPA considers impact upon smaller, susceptible subpopulations in assessing the risk at issue. *See* Dkt. No. 400, Feb. 5, 2024, Trial Tr. at 587:7-18 (Barone) (testifying that the EPA considered impact on small, susceptible subgroup of population in regulating lead).

c. As Dr. Grandjean explained, women in the 95th percentile exposure level to fluoride exceed the BMCL for a 1-point loss in IQ by over a factor of four. *See* Dkt. No. 397, Feb. 2, 2024, Trial Tr. at 358:2-18 (Grandjean). Indeed, when considering high-end exposure levels, relative to Dr. Grandjean's BMCL identifying the dosage at which a 1-point IQ decrement is expected, fluoride presents a risk of a decrease in IQ ranging from 2.86 to 6.75 IQ points.[36]

116. **Exposure-related considerations** (*e.g.*, duration, magnitude, or frequency of the exposure, and size of the affected population) weighs heavily toward finding the risk at issue unreasonable; the exposure is continuous, and nearly all Americans are affected.

[36] According to Dr. Grandjean's analysis, an increase of 0.28 mg/L of fluoride exposure (measured in maternal urinary fluoride) is associated with a 1-point IQ loss in the mother's offspring (boys and girls). *See* Dkt. No. 432-15, Trial Ex. 119 (Grandjean (2023)) at 1-2, 9. Pregnant mothers in fluoridated communities in the United States have a median and 95th percentile exposure level to fluoride of 0.8 mg/L and 1.89 mg/L, respectively (measured in maternal urinary fluoride). *See* ¶¶ 86-88; Trial Ex. 122, Dkt. No. 432-18 at, Trial Ex. 122 at 9. Thus, fluoride presents a hazard of reduced IQ ranging from approximately 2.86 points at the median intake level,((0.8 mg/L (median exposure level) divided by 0.28 mg/L (dosage at which 1 IQ point decrease is observed)), *i.e.*, 2.857) to 6.75 points at the 95th percentile ((1.89 mg/L (95th percentile exposure level) divided by 0.28 mg/L (dosage at which 1 IQ point decrease is observed)), *i.e.*, 6.75).

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117. The size of the affected population is vast. Approximately 200 million Americans have fluoride intentionally added to their drinking water at a concentration of 0.7 mg/L. *See* Dkt. No. 421 at 206-07 (undisputed). Other Americans are indirectly exposed to fluoridated water through consumption of commercial beverages and food manufactured with fluoridated water (*i.e.*, the "halo effect"). *See, e.g.*, Dkt. No. 401, Feb. 6, 2024, Trial Tr. at 799:7:800:13 (Thiessen) (describing the "halo effect" of water fluoridation); Dkt. No. 396, Feb. 1, 2024, Trial Tr. at 212:7-23 (Lanphear) (similar). *See also* Dkt. No. 432-4, Trial Ex. 108 at 6-7 (describing the "diffusion or halo effect" . . . "which refers to the extension of fluoridation to residents of nonfluoridated communities as a result of foods and beverages that are commercially processed in fluoridated areas and consumed in nonfluoridated communities") (citing Griffin et al. 2001; Ripa 1993). Approximately two million pregnant women, and over 300,000 exclusively formula-fed babies are exposed to fluoridated water. Dkt. No. 421 at 209-210. *See also* Dkt. No. 401, Feb. 6, 2024, Trial Tr. at 815:6-816:23 (Thiessen). The number of pregnant women and formula-fed babies alone who are exposed to water fluoridation each year exceeds entire populations exposed to conditions of use for which EPA has found unreasonable risk; the EPA has found risks unreasonable where the population impacted was less than 500 people. *See* Dkt. No. 400, Feb. 5, 2024, Trial Tr. at 588:11-15 (Barone) (testifying that under TSCA the EPA had made unreasonable risk determinations for conditions of use that involve less than 500 people, and that "many are less than 500 people"). *See also* Dkt. No. 421 at 209-210 (EPA agreeing that "the exposed population for the condition of use of community water fluoridation exceeds the exposed populations of the first ten risk evaluations under Amended TSCA").

a. Individuals are exposed to fluoride through water intake every day; the parties do not dispute that frequency of exposure for most people is several times daily (*i.e.*, through drinking tap water). Dkt. No. 421 at 207 (undisputed).

b. And the duration of exposure to fluoridated water is continuous with its effects long-lasting. *See* Dkt. No. 401, Feb. 6, 2024, Trial Tr. at 813:18-20 (Thiessen) (describing that exposure to community water fluoridation is intended to be lifelong). To this end, fluoride remains in the body through years; for several years after cessation of fluoride exposure a woman is likely to release fluoride into blood due to skeletal breakdown. Dkt. No. 397, Jan. 31, 2024, Trial Tr. at 370:6-371:12 (Grandjean); Dkt. No. 402, Feb. 8, 2024, Trial Tr. at 932:16-20 (Thiessen).

118. The **susceptibility** of exposed populations weighs heavily toward finding the risk at issue unreasonable. It is undisputed that large numbers of susceptible individuals are being exposed each year to fluoride through fluoridation, namely, approximately two million **pregnant women**, and over 300,000 exclusively formula-fed **babies**. Dkt. No. 421 at 209-210. *See also* Dkt. No. 401, Feb. 6, 2024, Trial Tr. at 815:6-816:23 (Thiessen).

119. The scientific literature in the record provides a high level of certainty that a hazard is present; fluoride is associated with reduced IQ. There are uncertainties presented by the underlying data regarding the appropriate point of departure and exposure level to utilize in this risk evaluation. But those uncertainties do not undermine the finding of an unreasonable risk; in every scenario utilizing any of the various possible points of departures, exposure levels and metrics, a risk is present in view of the applicable uncertainty factors that apply:

a. Regarding the point of departure, as discussed above, there is some uncertainty regarding the appropriate point of departure to utilize. Specifically, there is lack of certainty regarding the model fit to be utilized in the BMD modeling analysis, which determines the BMCL to utilize as a point of departure. *See* ¶ 72 (discussing use of linear vs. squared model to derive BMCL). However, under either scenario (whether using a linear or squared model), there is an insufficient safety margin between the exposure level and hazard level; a risk is present. *See* ¶¶ 102-106. Even assuming BMD modeling cannot be used for the data set and using a highly conservative LOAEL of 4 mg/L, a risk remains present by a substantial margin. *See* ¶¶ 107-111. Accordingly, the uncertainty regarding the point of departure (hazard level) is ultimately not consequential to the conclusion herein. The EPA has deemed a risk unreasonable even where it lacked high confidence in the hazard data. *See* Dkt. No. 421 at 211 (undisputed).

b. Regarding the exposure level, there is uncertainty presented by the fact that a PBPK model was not utilized to determine the precise amount of fluoride reflected in pregnant women's maternal urinary fluoride levels that derives from fluoridated water. *See* ¶ 91(b).

Uncertainty due to lack of modeling is offset by the fact that it is appropriate to view risk presented by water fluoridation in context of its additive effects on aggregate exposure, which is best reflected by real world maternal urinary fluoride levels. *See* ¶¶ 89-90. And this is particularly true where, as here, water fluoridation is known to be a significant contributor to maternal urinary fluoride levels, and indeed functions roughly as a 2x multiplier to those levels. *See id.* Further, here, there is real-world observational data showing what the maternal urinary fluoride levels of women that live in communities with fluoridation levels comparable to that of the United States; this data makes the PBPK model less critical to the analysis. *See* ¶¶ 89-91. The uncertainty from the lack of PBPK model weighs against finding the risk unreasonable, but not strongly so due to these mitigating circumstances. Moreover, when utilizing the conservative LOAEL as a point of departure, that metric is derived from water fluoride intake, and does not present the same uncertainty posed by using maternal urinary fluoride levels as the metric of hazard and exposure. Finally, the EPA has deemed a risk unreasonable even where it lacked high confidence in the exposure data. *See* Dkt. No. 421 at 211 (undisputed).

c. There is significant *certainty* in the data set regarding the association between fluoride and reduced IQ. Namely, there is a robust body of evidence finding a statistically significant adverse association between fluoride and IQ. A large majority of the 72 epidemiological studies assessed by the NTP Monograph observed this relationship including all but one of the 19 high-quality studies, *see* ¶¶ 34-36, and literature published after the NTP Monograph cutoff date observed the same relationship, *see* ¶ 37 – and countervailing evidence, for various reasons described previously, are of little impact on this repeated, and consistently observed association between fluoride and reduced IQ, *see* ¶ 39. Moreover, complete consistency amongst studies is not expected. *See* Dkt. No. 414, Feb. 9, 20240, Trial Tr. at 1172:23-1173:6 (Savitz). Notably, notwithstanding inherent difficulties in observing this association at lower exposure levels, studies assessing such levels still observed a statistically significant relationship between fluoride and reduced IQ. *See* ¶¶ 42-44. Again, to put the breadth of evidence supporting this finding in perspective, the EPA has identified a LOAEL based upon far less in other contexts. For instance, in the EPA's risk evaluation of Methylene, conducted pursuant to Amended TSCA, the EPA used a LOAEL for developmental neurotoxicity, derived from the analysis of ***one study conducted upon mouse pups*** (Fredriksson et al., 1992). *See* Methylene Risk Evaluation at 262. Compare this with 6 (water fluoride) and 9 (urinary fluoride), high-quality, epidemiological studies of human populations underling the 4 mg/L LOAEL underlying the POD here. Dkt. No. 431-2, Trial Ex. 68 at 39, 41 (eTable 4). The scientific literature in the record provides a high level of certainty that a hazard is present; fluoride is associated with reduced IQ. The qualitative evidence is superior.

120. In sum, the first three factors weigh toward finding the risk unreasonable. Namely, the severity of the hazard weighs toward finding the risk unreasonable. The exposure-related considerations and exposure of susceptible populations weighs *strongly* toward finding the risk unreasonable; millions of susceptible individuals are exposed to fluoride and the exposure is frequent and long-lasting. The two final factors, confidence in hazard data and overall strength of the evidence and uncertainties, are largely neutral. Because the first three factors weigh strongly toward finding the risk unreasonable and the last two are largely neutral, the totality of the factors establish that the risk is unreasonable under the Amended TSCA. The Court thus finds that the Plaintiffs have established by a preponderance of the evidence that the risk at issue is **unreasonable**.

IV. CONCLUSIONS OF LAW

121. Plaintiffs have proven, by a preponderance of the evidence, that water fluoridation at the level of 0.7 mg/L – the prescribed optimal level of fluoridation in the United States – presents an "unreasonable risk of injury to health or the environment, without consideration of costs or other non-risk factors, including an unreasonable risk to a potentially exposed or susceptible subpopulation under the conditions of use." 15 U.S.C. § 2620(b)(4)(B)(ii).

122. The Court thus orders the Administrator to initiate rulemaking pursuant to Subsection 6(a) of TSCA. *See id.* §§ 2605(a), 2620(a).

123. The Court defers ruling as to whether Plaintiffs are entitled to recovery of their costs of suit and attorneys and expert witness fees. Parties are ordered to submit a proposed supplemental briefing schedule regarding costs and fees within two weeks of the date of this order.

Defendant shall respond two weeks thereafter. The Court will take the matter under submission unless it orders a hearing.

The Clerk of Court is directed to enter judgment in Plaintiffs' favor.

IT IS SO ORDERED.

Dated: September 24, 2024

EDWARD M. CHEN
United States District Judge

United States District Court
Northern District of California

From: bill teachingsmiles.com
Sent: 8/22/2024 9:22:32 AM
To: DOH WSBOH
Cc:
Subject: National Toxicology Report Published

External Email

Please provide this review to Board Members as Public Comment.
Review of NTP Monograph
<https://gcc02.safelinks.protection.outlook.com/?url=https%3A%2F%2Fntp.niehs.nih.gov%2Fwhatwestud
on the State of the Science Concerning Fluoride Exposure and Neurodevelopment and Cognition: A Systematic Review NTP Monograph August 2024
https://ntp.niehs.nih.gov/whatwestudy/assessments/noncancer/completed/fluoride
Fluoride harms the brain, lowers intelligence.

The National Toxicology Program, the highest advisor to the Nation on toxins, took nine years to do what they told me would be a 2-year report. For years, the draft report has been attacked, delayed, suppressed and the meta-analysis, the most crushing blow to fluoride, has even now been further delayed. However, the first part of the report has been published, including:

"This review finds, with moderate confidence, that higher estimated fluoride exposures (. . . water with 1.5 mg/L) are consistently associated with lower IQ in children."

"Seventy-two studies assessed the association between fluoride exposure and IQ in children. Nineteen of those studies were considered to be high quality; of these, 18 reported an inverse association between estimated fluoride exposure and IQ in children."

"Additional exposures to fluoride from other sources would increase total fluoride exposure. The moderate confidence conclusions may also be relevant to people living in optimally fluoridated
areas of the United States depending on the extent of their additional exposures to fluoride from sources other than drinking water."

Concentration mg/L of fluoride in water is not dosage, mg/Kg body weight 1.5 mg/L (ppm) of fluoride is about twice the amount or concentration added to public water at 0.7 mg/L and is argued as safe by the fluoridation lobby; however, concentration is not dosage. Calculations are made assuming every adult drinks the "mean" or "average" amount of water, about a quart or 4 glasses of water per day according to EPA's 2010 Dose Response Analysis and NRC 2006 Report on fluoride. The population at the 90th percentile drink 2 liters/day and 10% of the population drink over 2 liters/day and some drink over 10 liters/day. A pregnant mom, laborer, diabetic, and others easily drink 8 glasses of water a day. Ingesting 2 liters (8 glasses) at 0.7 mg/L is about the same as 1 liter at 1.5 mg/L which the NTP now reports with moderate confidence is harmful to the developing brain.

Nor does concentration of fluoride in water consider someone swallowing some fluoride tooth-paste, eating non-organic foods high in fluoride, or eating mechanically deboned meat high in fluoride from the bone ground up in the meat, or fluoride post-harvest fumigated foods using Parfume (a fluoride fumigant), or a person taking medications with fluoride, or fluoride anesthesia that can have a huge spike in fluoride serum levels.

Of most concern is the harm fluoride causes to the developing brain of the fetus and infant. Mom's must not drink fluoridated water or swallow fluoridated toothpaste.

For FAN’s excellent press release on the NTP report, see :
https://fluoridealert.dm.networkforgood.com/emails/3475670?recipient_id=mm17CzRN74OK3NF_WE7ibw%

<https://gcc02.safelinks.protection.outlook.com/?url=https%3A%2F%2Ffluoridealert.dm.networkforgood.c

For a good article from the Associated Press, see https://www.whec.com/national-world/us-government-report-says-fluoride-at-twice-the-recommended-limit-is-linked-to-lower-iq-in-kids/
<https://gcc02.safelinks.protection.outlook.com/?url=https%3A%2F%2Fwww.whec.com%2Fnational-world%2Fus-government-report-says-fluoride-at-twice-the-recommended-limit-is-linked-to-lower-iq-in-kids%2F&data=05%7C02%7CWSBOH%40SBOH.WA.GOV%7C5e8c9bd1e79a46174f8508dcc2c69e16%7C1

And Further:
The NTP review on fluoride’s developmental neurotoxicity starts out with clear bias, falsely claiming benefit from fluoride: “Since 1945, the use of fluoride has been a successful public health initiative for reducing dental cavities and improving general oral health of adults and children.”

However, the “Application” concludes: The Monograph “It does not, and was not intended to, assess the benefits of fluoride.”

The US FDA says the evidence for ingesting fluoride is “incomplete.” The EPA scientists agree, fluoridation does not have benefit. There are no high-quality studies, randomized controlled trials, reporting benefit from fluoride ingestion in reducing dental caries.

The original Monograph draft determined there was a “presumed“ confidence of harm to the brain. ThisMonograph concluded there is “moderate confidence in the scientific evidence that showed an association between higher levels of fluoride and lower IQ in children.”
P. xviii “The literature in children was more extensive and was separated into studies assessing intelligence quotient (IQ) and studies assessing other cognitive or neurodevelopmental outcomes. Eight of nine high-quality studies examining other cognitive or neurodevelopmental outcomes reported associations with estimated fluoride exposure. Seventy- two studies assessed the association between fluoride exposure and IQ in children. Nineteen of those studies were considered to be high quality; of these, 18 reported an inverse association between estimated fluoride exposure and IQ in children. The 18 studies, which include 3 prospective cohort studies and 15 cross-sectional studies, were conducted in 5 different countries. Forty-six of the 53 low-quality studies in children also found evidence of an inverse association between estimated fluoride exposure and IQ in children.”
P 1 “Note that while drinking water provides the majority of fluoride exposure in many of the studies, total exposure can vary widely even in optimally fluoridated areas based on personal habits in the use of dental products and consumption of beverages such as black tea that can contain fluoride. “
“In addition, a meta-analysis of the epidemiological studies examining children’s IQ in relation to fluoride exposure added to the 2020 draft in response to NASEM comments (NASEM 2020) was removed for further refinement in preparation for a separate publication and is not part of this document.”
The removed meta-analysis is more damning to fluoridation finding no safe level of fluoride to the developing brain. We will see how the fluoridation lobby can influence the refining of the empirical evidence in their attempt to protect fluoridation.

Again, on page 3, the report emphasizes the removal of the most serious evidence. “In addition, a meta-analysis of the epidemiological studies examining children’s IQ in

relation to fluoride exposure added to the 2020 draft in response to NASEM comments (NASEM 2020) was removed for further refinement in preparation for a separate publication and is not part of this document.
Studies reviewed included:

1. "167 human studies (84 primary only; 13 secondary only; 5 primary and secondary; 8 primary and thyroid; 2 secondary and thyroid; and 55 thyroid only);
2. 339 non-human mammal studies (7 primary only; 186 secondary only; 67 primary and secondary; 6 primary, secondary, and thyroid; 4 secondary and thyroid; and 69 thyroid only); and,
3. 60 in vitro/mechanistic studies (48 neurological and 12 thyroid)."

No one has suggest that further studies will lower the risk of fluoride. More studies will only increase our concern for sub-populations, age, race, gender, and those with synergistic toxins, DNA sensitive, autistic, etc.
The fluoridation lobby and tobacco lobby are very similar. The fluoridation lobby, which includes those profiting from fluoride, will attempt to raise "doubt." In court the dental lobby was asked by Judge Chen, "what would it take to change your mind?" The expert responded, "one or two more studies." The same delaying answer the tobacco lobby has used for more than half a century. Consider the number of studies list above, total over 500. The effect of one or two more studies would not likely make a difference. The only purpose for wanting one or two more is to delay, raise doubt, require a new legal battle, raise uncertainty, protect the profits of industry.
Review as of August 22, 2024 by Bill Osmunson DDS MPH

Date: October 8, 2024

To: Washington State Board of Health Members

From: Patty Hayes, Board Chair

Subject: Variance Request (Cheney) – WAC 246-262-060(5)(b)(vi) Diving Envelope Requirements

Background and Summary:

RCW 70.90.120 authorizes the State Board of Health (Board) to adopt rules governing safety, sanitation, and water quality of water recreation facilities. WAC 246-262-160 sets the process for variance requests. The Board has the sole discretion to approve variance requests, if the Board determines the data and research provides sufficient evidence that the variance will adequately protect public health and safety.

On July 17, 2024, the Board received a variance request from Brooke Hanley of NAC Architecture requesting a variance approval of three separate pieces of equipment as they relate to diving envelope requirements, as defined in WAC 246-262-010(21), definition of diving envelope, and as regulated under WAC 246-262-060(5)(vi). The equipment includes a NinjaCross Obstacle Course, AquaZip'n Rope Swing, and a climbing wall.

On August 7, 2024, Board and Department of Health staff introduced the variance requests to the Board. Due to the large size of supporting documentation, staff needed additional time to complete the review and consider whether a variance would adequately protect public health and safety, in order to provide the Board with complete information for their determination.

Staff has completed a review of the variance requests. Board Policy Advisor Shay Bauman will introduce the topic and set expectations for reviewing the materials. Dave DeLong with the Department of Health will present the Board with additional engineering information related to the requests and recommendations.

Recommended Board Actions:

The Board may wish to consider and amend, if necessary, the following motions:

Aquaclimb

The Board moves to grant a variance to WAC 246-262-060(5)(b)(vi), diving envelope requirements, to install a climbing wall as specified by the variance request at the Cheney Aquatic Center, subject to the conditions recommended by the Department of Health and Spokane Regional Health District.

OR

The Board moves to deny the variance request to WAC 246-262-060(5)(b)(vi), diving envelope requirements to install a climbing wall, as specified by the variance request, at the Cheney Aquatic Center.

AquaZip'N Rope Swing

The Board moves to grant a variance to WAC 246-262-060(5)(b)(vi), diving envelope requirements, to install an AquaZip'N Rope Swing as specified in the variance request at the Cheney Aquatic Center, subject to the conditions recommended by the Department of Health and Spokane Regional Health District.

OR

The Board moves to deny the variance request to WAC 246-262-060(5)(b)(vi), diving envelope requirements to install an AquaZip'N Rope Swing as specified in the variance request at the Cheney Aquatic Center.

Ninja Cross

The Board determines that the installation of a Ninja Cross obstacle course as specified in the variance request does not require a diving envelope and therefore does not require a variance for installation.

OR

The Board moves to grant a variance to WAC 246-262-060(5)(b)(vi), diving envelope requirements, to install a Ninja Cross obstacle course as specified in the variance request at the Cheney Aquatic Center, subject to the conditions recommended by the Department of Health and Spokane Regional Health District.

OR

The Board moves to deny the variance request to WAC 246-262-060(5)(b)(vi), diving envelope requirements to install a Ninja Cross obstacle course as specified in the variance request at the Cheney Aquatic Center.

Staff
Shay Bauman, Policy Advisor

NAC ARCHITECTURE

Patty Hayes, Board Chair
Washington State Board of Health
PO Box 47990
Olympia, WA 98504-7990

CHENEY AQUATIC CENTER Variance Letter Date: 2024.06.25

PROJECT IDENTIFICATION: Lap Pool #: SR009200 Leisure Pool #: SR009201

On Behalf of:
Cheney Aquatic Center, City of Cheney
Owner Contact: Dan Curley Phone: 509-498-9293
Owner Address: 609 2nd Street Cheney, WA 99004
Facility Address: 115 North 8th Street (formerly 711 Cedar Street), Cheney, WA 99004

Owner Representative: Brooke Hanley (NAC Architecture) 509-838-8240

Variance Request Contact:
NAC Architecture: Brooke Hanley Phone: 509-838-8240 Email: bhanley@nacarchitecture.com

Facility Information:
Cheney Aquatic Center - Project includes an outdoor 6-lane 25-yard lap pool & separate leisure pool with zero-entry, spray features, & lazy river. The pool building with locker rooms, lifeguard offices, party room, and mechanical spaces is about 5000sf. The entire facility is lifeguarded and enclosed securely.

Plan Submittal: Drawing Plans have been submitted for review.

Variance Request Citation:
WAC 246-262-160 states *the board may grant a variance from requirements of chapter* ***246-262*** *WAC if, in the sole discretion of the board, data and/or research provides sufficient evidence that the RWCF (attraction, device, equipment, procedure, etc.), will adequately protect public health and safety, as well as water quality.*

Variance Request: Code Related to Diving Envelope (WAC 246-262-010(21) & WAC 246-262-060(5)(vi)) for a **climbing wall** attraction.

Items noted in review letter include:

- **Climbing wall** attraction receiving pool shall meet the 2000-2001 FINA facility rules (depth application and setbacks)

In the Spokane Regional Health District review response issued by Steve Main dated May 24, 2024, Steve requests NAC Architecture (NAC) and WaterTechnology, Inc. (WTI) address important concerns regarding public safety related to the receiving pool for the proposed **climbing wall** attraction in Pool B. The concern is to address the minimum depth of the pool to be compliant with the WAC 246-262-010(21) & WAC 246-262-060(5)(c)(vi) regarding diving envelopes for features where users enter the water at 20" or higher above the water surface.

On behalf of the City of Cheney; NAC & WTI respectfully request your consideration of the current pool depth design at the climbing wall for the future Cheney Aquatic Center. To support this request we provide the attached information, engineering exhibits, and following commentary:

- The review letter states that the "diving envelope" from WAC 246-262-010(21) applies to **all attractions** where users enter above pool water level and therefore requires the CNCA (enter less than 20" above the water surface) or FINA (enter 20" or greater above the water surface) water depths. We submit that the attached engineering calculations for the **AquaClimb 5-Panel-High & 5-Panel-High-Alt climbing wall** products will demonstrate that the manufacturer's required water depths and the designed water depths provided at the Cheney Aquatic Center are sufficient to protect the safety of the range of users allowed to participate in this attraction. Calculations were completed for a 48" tall, 50lbs person and a 78" tall, 250lbs person to show a range of sizes requested in the review letter. Please reference page 9 for the manufacturer's minimum depth requirements and pages 10-17 for the engineering calculations and associated notes. The Cheney design provides for greater water depth than the minimum required by this engineering report as noted in the attached information. Please review the attached data in support of using the manufacturer's depth requirements in lieu of the CNCA or FINA diving envelope dimensions.

- WAC 246-262-060(5)(c)(vi) appears to apply specifically to "diving envelopes in pools or areas of pools designated for diving activities". The applicant submits that diving activities are generally defined as plunging into the water headfirst. Diving headfirst into water results in the need for deeper water to avoid a head & neck collision with the bottom of the pool which is different than a feet-first or tucked entry plunge where the body is significantly slowed in the first two feet of water. The **climbing wall** safety guidelines and standard operating procedures (provided in the exhibits) will note that users are required to re-enter the water in a feet-first manner. Diving from the unit is prohibited (and per the manufacturer data, bio-mechanically improbable). The engineering calculations completed also assume a feet-first plummet into the water.

- The Model Aquatic Health Code also addresses the complexity of "other aquatic features" like **climbing walls** and would suggest that the manufacturer recommendations for design and operation would be adequate to install the feature.

  4.12.10[A] Other Aquatic Features Other AQUATIC FEATURES not otherwise addressed in the CODE, including but not limited to climbing walls, inflatables, and play structures, shall not be installed unless designed and operated in accordance with all manufacturer's installation and operations recommendations.

- 'A-frame' signs with all written safety guidelines will be publicly displayed near the **climbing wall** (see page 18 for example) to meet the criteria of WAC 246-262-070(10). The design team could also instruct AquaClimb to add a maximum height of 78" to the sign to correspond to the engineering calculations, if this would mitigate concerns over swimmers participating that do not fit within the engineering assumptions.

- See attached climbing wall diagram. The frame and panels of the wall tilt out over the water, ensuring the swimmer's descent is away from the wall and pool edge. The protective panels at the top do not have hand-holds and therefore prevents climbing over the top of the structure. The "Alt" panel climbing wall does not provide hand holds as high as the full 5 panel system and therefore requires less minimum water depth per the manufacturer's recommendations.

- This pool will be lifeguarded at all times while in operation and the lifeguard staff will be the first line of defense to screen bathers to make sure they are experienced swimmers, instruct swimmers on proper use of the attraction, and direct proper swimmer circulation to and from the activity within the pool to avoid congestion or collisions. The **climbing wall** will have a dedicated lifeguard to closely supervise the safety of swimmers when the attraction is open for use. Cheney is dedicated to making this facility fun while also as safe as possible for their community members and patrons.

- The product literature, research paper, and testing tout the relative safety of the **climbing wall** compared to diving boards and slides. They also have over 1,000 installations across the world. See the provided letter from Aquatic Safety Research Group.

- The **AquaClimb** has also been designed and engineered to meet the following standards:
    - ASTM F24/F2291-21 Standard Practice for Design of Amusement Rides and Devices
    - ASTM F2461-20 Aquatic Play Equipment
    - European Standards EN17164 – Climbing walls for use in the water area
    - IBC 2018 & AISC Manual of Steel Construction
    - Other industry standards listed in the product data attached

- NAC submits that the design as described above and substantiated in the attached documentation meets the intent of providing a safe receiving pool for the **climbing wall** feature. NAC, WTI, and the City of Cheney respectfully requests a variance accordingly. If the State Board of Health has any follow-up conditions or actions required of the owner/operator, we are committed to reviewing them for implementation.

NAC Architecture (NAC) has teamed with Water Technology (WTI) on numerous aquatic projects and so we have a history of producing these projects successfully. WTI has been designing Aquatic venues for over 40 years. WTI is widely known in the industry as one of the leading aquatic design firms in North America. As one of the industry's leaders, WTI has represented the waterpark industry during CPSC meetings on review of VGB rules and has also been involved in reviewing/editing sections of the MAHC. They are also represented in the Washington DOH committee to update the existing administrative code to adopt a more comprehensive aquatic code like the MAHC. The NAC and WTI commitment to safe aquatic facilities is proven. The design of the receiving pool at the **climbing wall** for the Cheney Aquatic

Center will not put the health and safety of the public at risk. The City of Cheney, having operated a public pool for many years is experienced and committed to the safety and the welfare of their patrons.

On behalf of the City of Cheney, NAC Architecture would like to thank you for your consideration of this Variance Request. Please feel free to contact me with any questions you may have regarding this request.

Thank you,

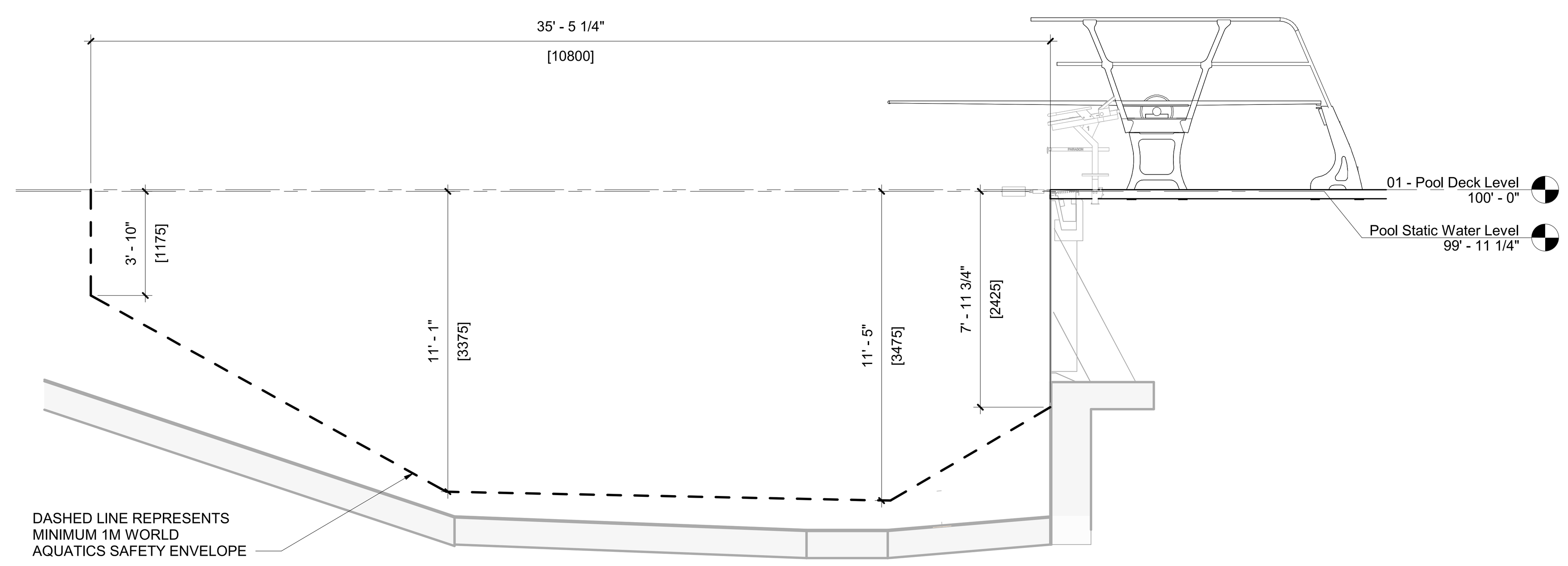
Brooke Hanley

Brooke Hanley, AIA, Principal Architect, NAC Architecture

Attachments:

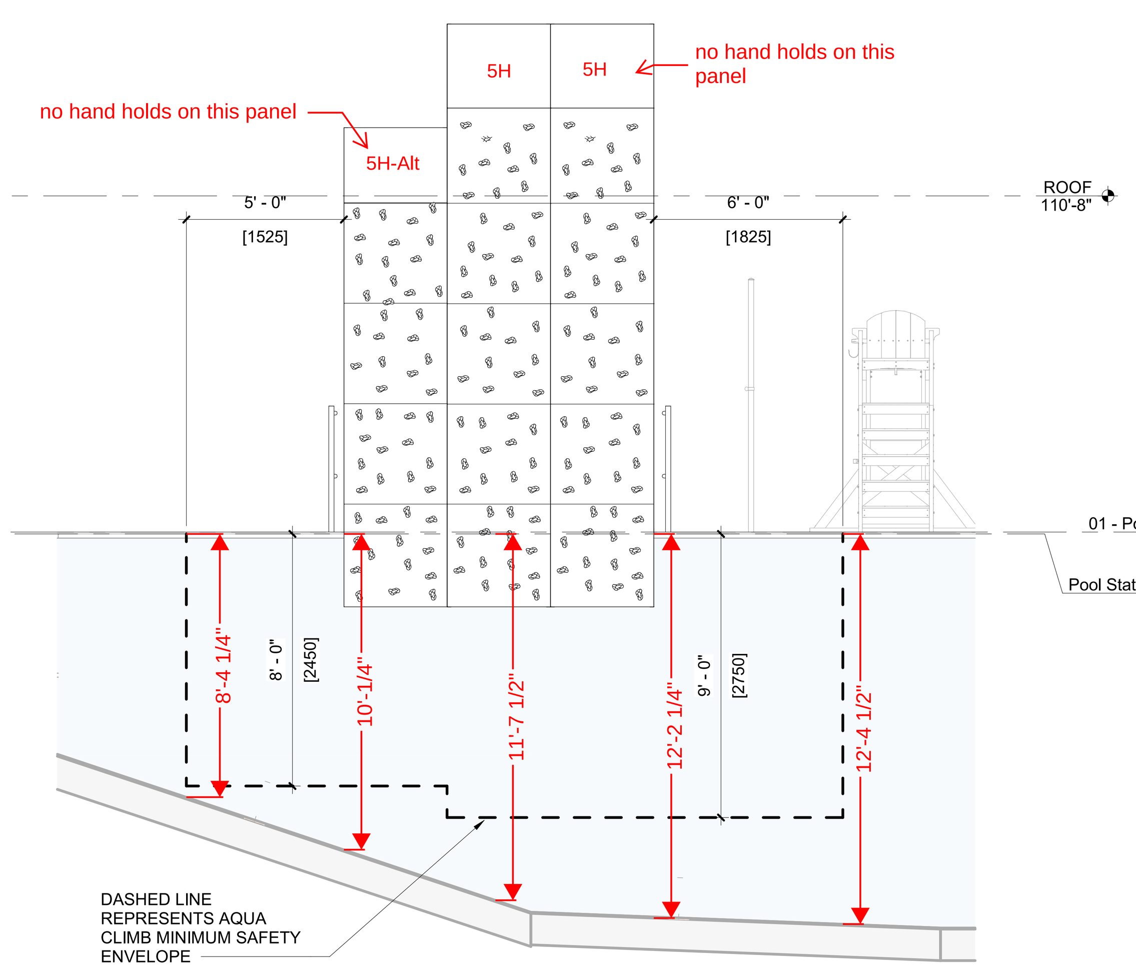
- AquaClimb Safety and Fall Zone Engineering, including a floor plan and section of the receiving pool as designed for the Cheney Aquatic Center.

NOTE:
ALL LANE DIVIDERS AND BACKSTROKE FLAGS MUST
BE REMOVED WHILE DIVING BOARD IS IN USE.



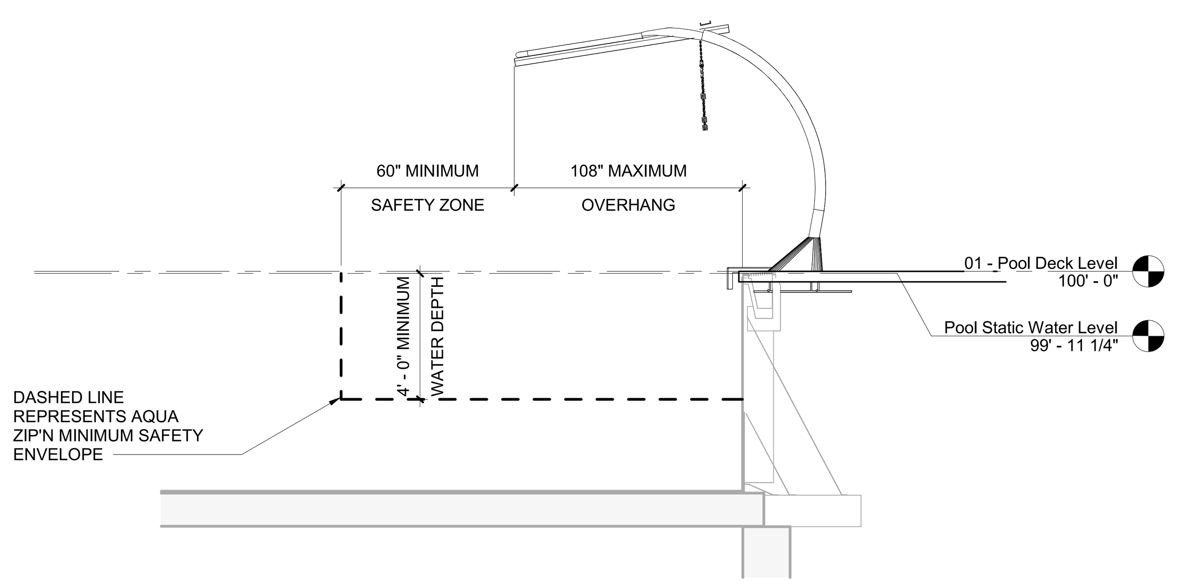
2 PL115 POOL A - LAP POOL DIVING SAFETY ENVELOPE
SECTION VIEW
1/4" = 1'-0"

NOTE:
ALL LANE DIVIDERS AND BACKSTROKE FLAGS MUST
BE REMOVED WHILE CLIMBING WALLS ARE IN USE.



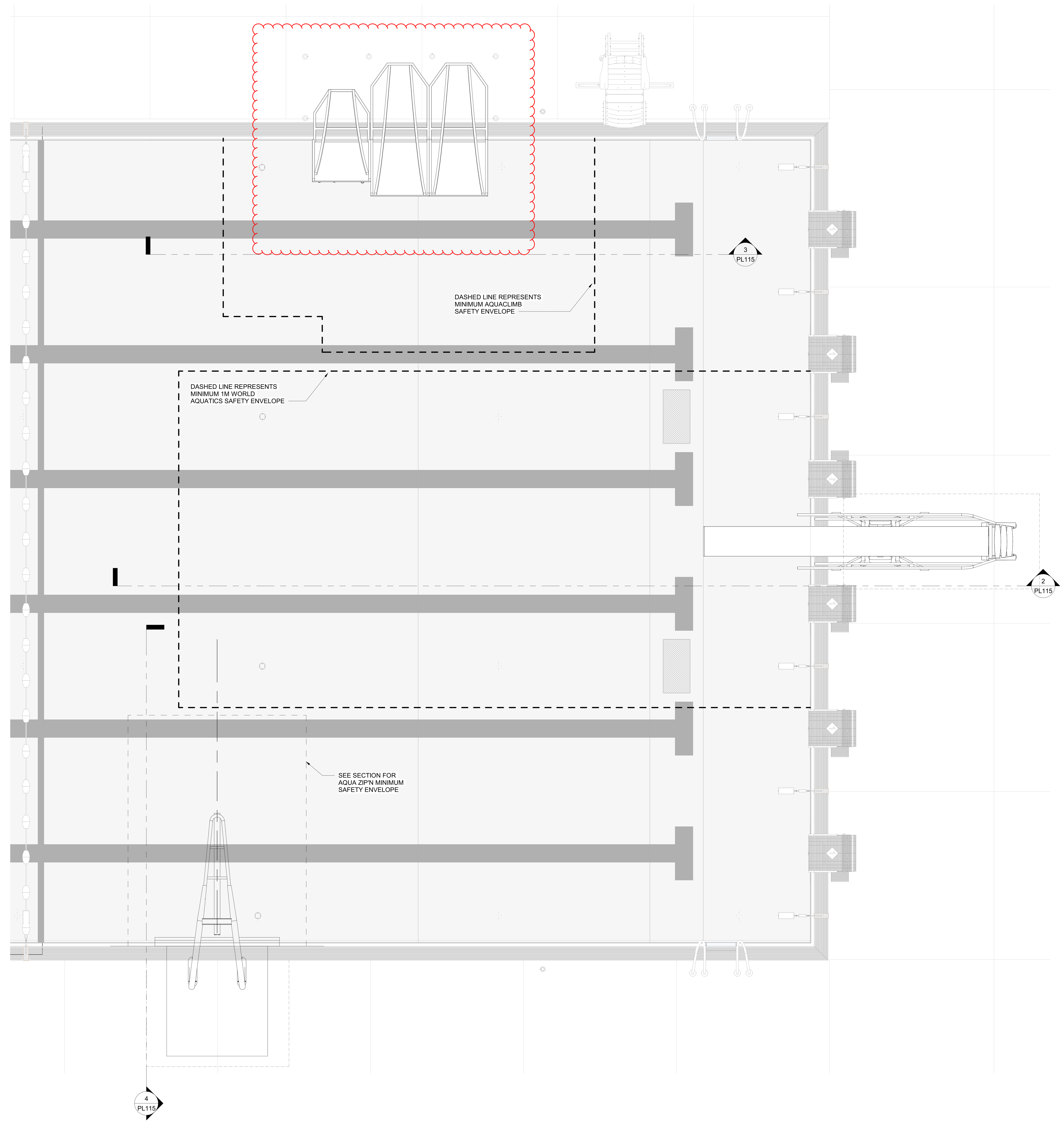
3 PL115 POOL A - LAP POOL CLIMBING WALL SAFETY ENVELOPE
SECTION VIEW
1/4" = 1'-0"

NOTE:
ALL LANE DIVIDERS AND BACKSTROKE FLAGS
MUST BE REMOVED WHILE AQUA ZIP'N IS IN USE.



4 PL115 POOL A - LAP POOL AQUA ZIP'N SAFETY ENVELOPE
SECTION VIEW
1/4" = 1'-0"

NOTE:
ALL LANE DIVIDERS AND BACKSTROKE FLAGS MUST BE
REMOVED WHILE CLIMBING WALLS, DIVING BOARD AND
AQUA ZIP'N ARE IN USE.



1 PL115 POOL A - LAP POOL SAFETY ENVELOPES
PLAN VIEW
3/8" = 1'-0"

REVISIONS

BID SET

WTI WATER TECHNOLOGY INC
World Leaders in Aquatic Planning, Design and Engineering
100 Park Avenue | Beaver Dam, WI 53916
T 920.887.7375 | #23458

CITY OF CHENEY
CHENEY AQUATIC CENTER
711 CEDAR ST. CHENEY, WA 99004

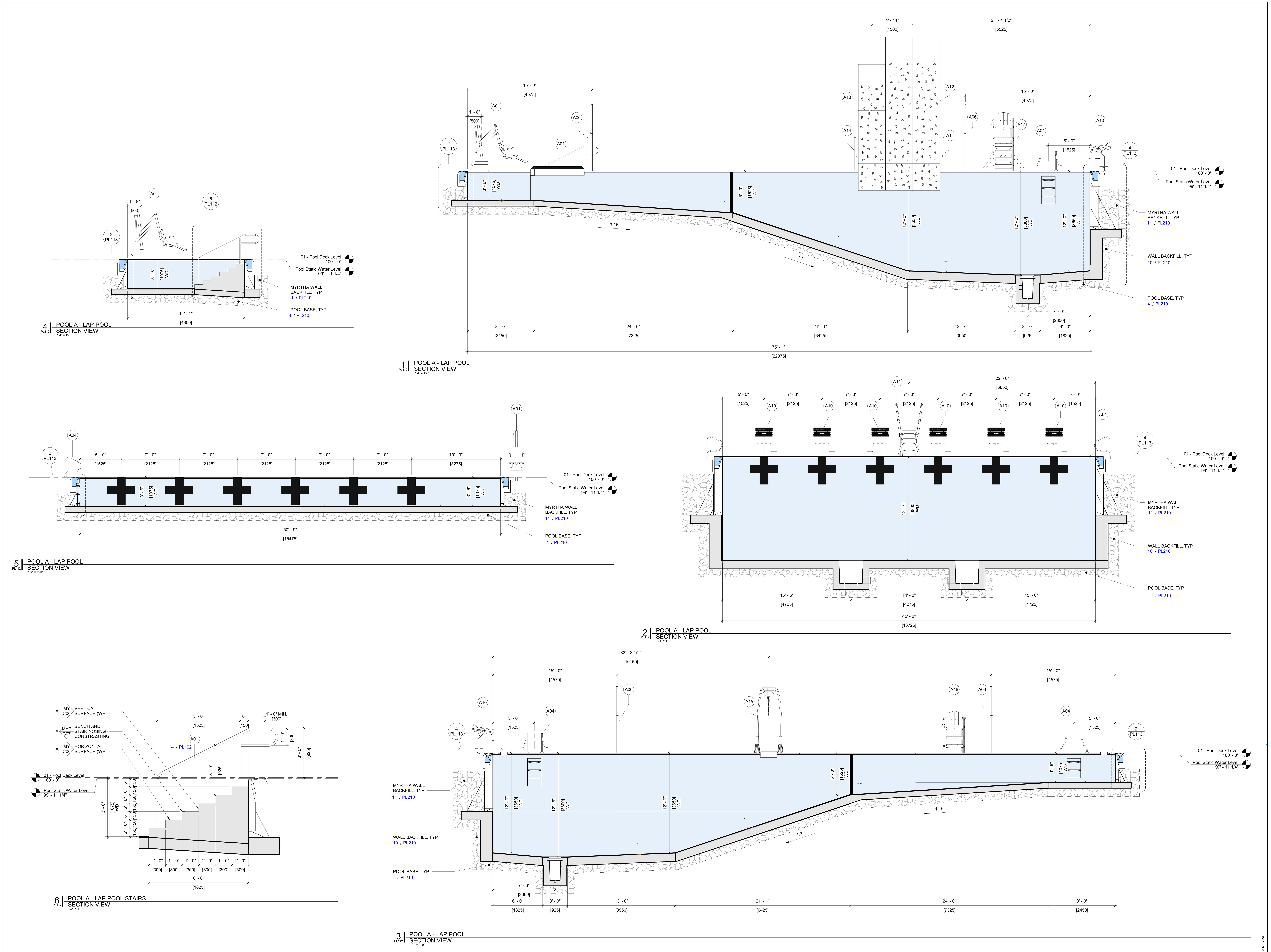
REGISTERED ARCHITECT
MATTHEW W. FRERBY
STATE OF WASHINGTON
4/16/2024

NAC ARCHITECTURE
nacarchitecture.com
1203 WEST RIVERSIDE AVE
SPOKANE WA 99201
P:509.838.8240

NAC NO	23458
DRAWN	MJC
CHECKED	GGA
DATE	04/16/2024

POOL A - LAP POOL
SAFETY
ENVELOPES

PL115



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REGISTERED ARCHITECT
MATTHEW W. FRERY
STATE OF WASHINGTON
4/16/2024

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nacarchitecture.com
1203 WEST RIVERSIDE AVE
SPOKANE WA 99201
P:509.838.8240

NAC NO	23458
DRAWN	MJC
CHECKED	GGA
DATE	04/16/2024

POOL A - LAP POOL SECTIONS

PL112

4/12/2024 10:10:05 AM Autodesk Docs://111-23084 Cheney Aquatic Center/Cheney_Aquatic-Pool-24.rvt

Turn your pool into an ADVENTURE with AquaClimb®

For recreation centers, fitness facilities, camps, and private clubs, AquaClimb expands poolside programming with an easy addition that is safe, engaging, and fun. As the market leader, AquaClimb offers more benefits to its customers than any other climbing product:

Modular and Customizable

AquaClimb's height, width, and panel style can all be tailored to fit the size and design of your pool, with options for adding more panels at a later phase as your budget allows.

Challenging, Realistic Climbing

With 3D contoured panels, AquaClimb delivers a realistic rock-climbing experience that engages adolescents through adults to conquer the climb in different ways.

Top Safety Record

With best-in-class safety features to ensure climbers fall away from the wall, AquaClimb also has a proven performance history from 1,000 installations across the globe.

Activates the Deep End

As a safer alternative or enhancement to diving boards, AquaClimb attracts tweens and teens to those under-utilized, deep areas of a pool.

Easy to Install

Because AquaClimb is pre-assembled in the factory, no specialized skills or equipment are required for onsite installation at your facility on any pool gutter configuration.

Minimal Footprint

AquaClimb's small deck-mounted system saves clearance space and doesn't interfere with normal lap swimming. And with no water source required, it is an easy amenity to add.

AQUACLIMB® Four Unique Models

AquaClimb Krystal

- Budget-friendly and entry-level option
- Modular, flat panels in clear, blue, and green transparent tint
- Customizable up to four height options sized to pool's depth

AquaClimb 3D

- 3D contoured panels for realistic climbing available in translucent **Ice, Glacier,** or **Jade** colors, and solid painted color schemes
- Modular panels can be turned and flipped to change up the experience
- Translucent panels allow lifeguard visibility while giving privacy to the climber behind the wall

AquaClimb Kurve

- Sleek, curved frame that allows heights up to 20 feet
- 3D contoured panels available in color options of Ice or Glacier
- Translucent panels allow lifeguard visibility while giving privacy to the climber behind the wall

AquaClimb Luxe

- Completely customizable design to match your pool's aesthetics
- 3D contoured panels
- Deck mounted or Pool wall mounted

AQUACLIMB® Depth Requirements

Panel Options	A Minimum Pool Depth	B Drop Zone	C Plummet line from wall	D Available climbing height	E Height of top foothold*	F Above deck wall height
3 High Alt	5'	9'	1'9"	8'10"	4'5"	9'7"
3 High	6'	9'	1'9"	9'10"	5'5"	9'7"
4 High Alt	6'	10'	2'6"	12'1"	7'8"	12'10"
4 High	7'	10'	2'6"	13'1"	8'8"	12'10"
5 High Alt	8'	12'	3'3"	15'5"	11'	16'1"
5 High	9'	12'	3'3"	16'5"	12'	16'1"
6 High (Kurve Only)	10'	12'	3'3"	17'	12'5"	19'8"

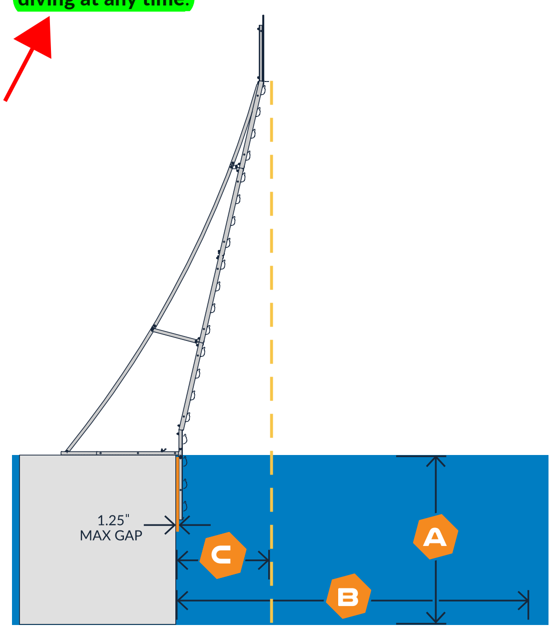
Cheney Products - see below for definition of Alt

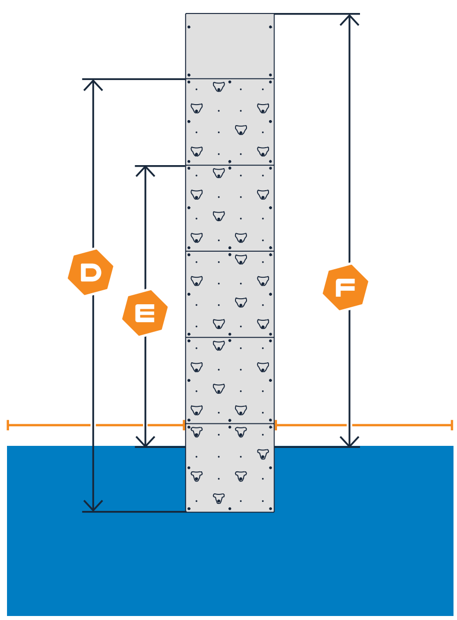
The Cheney project has a combination of a 5 high alt panel and (2) 5 high panels

*Based on climber's feet positioned at least 2' below highest hand grip

Alt - Alternate configurations will have the top row of handholds plugged for non-climbing terrain to meet pool depth requirements.

Important Safety Note: AquaClimb safety distances and pool depths are based upon a climber entering the water **feet first**. The AquaClimb was designed for a feet first entry at all times and supervision must be present when the AquaClimb is in use. To ensure the maximum level of safety, **there must be no diving at any time**.





Plummet Line

5 FT Fall Zone

*For installations that are 5+ panels high, a 6 FT Fall Zone is required.

FEAmax Report

AquaClimb Hand Calculation

FEAmax LLC.

PROJECT INFO.

Change History:

Version Number	Date	Summary	Author
V 1.0	2/2/2016	Initial release	Frank Wang

Client Information:

Contact name:	Laura Grandner
Email:	Laura@aquaclimb.com
Company name:	Pyramide USA
Address:	P.O. Box 530 Frederick, MD. 21705

PROJECT DESCRIPTION

- **Project Description**

1. Calculate the minimum depth required to safely plummet down from the highest foot hold point on the (4) levels of AquaClimb Walls (2H , 3H , 4H and 5H).
2. With the top climbing hold measurement provided – deduct 36” (3ft) down which would be the highest foot hold placement. Then with the following parameters calculate the minimum depth needed to safety let go and plummet straight down into the water without reaching the bottom floor of the pool.
3. Height: 48” minimum; 78” Maximum
4. Weight: 50 lbs minimum; 250 lbs maximum

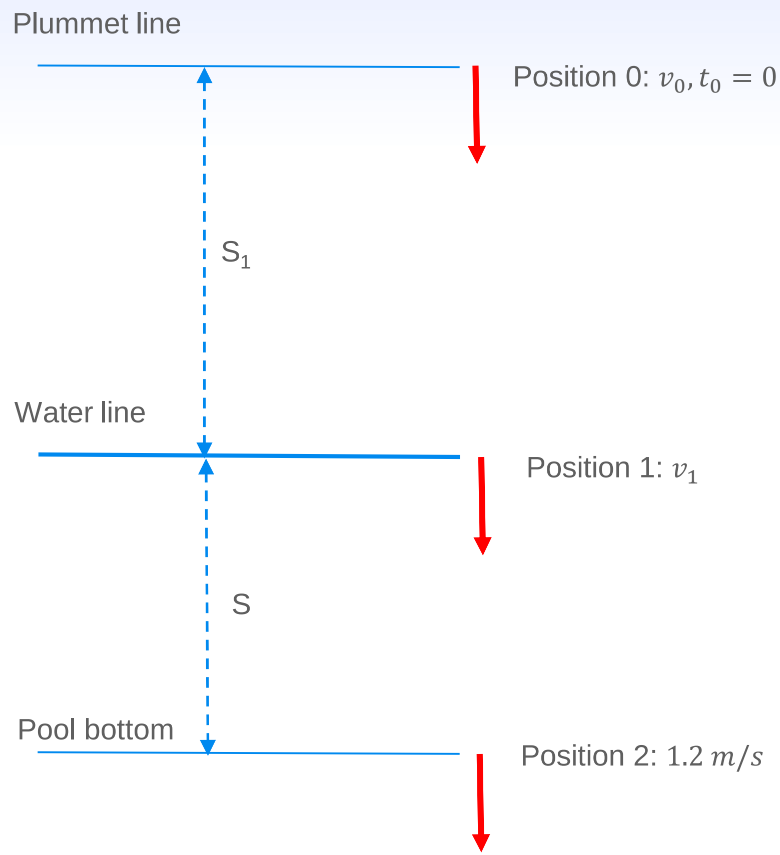
CALCULATION

Assumptions:

1. Minimum height of human body H_{human}= 48" = 1.2 meter
2. Water density ρ_{water}= 1.0 g/cm^3
3. Human body density ρ_{human}= 0.9 g/cm^3
4. The velocity enter the water = V_1
5. Water Resistance coefficient C_D = 1.0
6. Human body volume = V
7. Area of human body enter the water = A
8. Velocity of human body inside the water = V_x
9. The allowable decent velocity to the pool bottom = 1.2 m/s

Force applied to human body inside water:

1. Gravity $G = \rho_{human} gV$
2. Buoyancy (floating force) $F = \rho_{water} gV$
3. Water resistance force $F_{resistance} = \frac{1}{2}\rho_{water} V_x^2 A C_D$



CALCULATION

According to Newton's second law, we have:

1. The acceleration in the water: $a = \frac{dV_x}{dt} = \frac{F}{m}$

2. $a = \frac{\rho_{human} gV - \rho_{water} gV - \frac{1}{2}\rho_{water} V_x^2 AC_D}{\rho_{human} V} = \frac{0.9\times9.8\times V - 1.0\times9.8\times V - 0.5\times1.0\times V_x^2\times\frac{V}{1.2}\times1.0}{0.9\times V} = -(1.09 + 0.46V_x^2)$

3. $\frac{dV_x}{dt} = -(1.09 + 0.46V_x^2)$

4. $\mathrm{dt} = -\frac{dV_x}{(1.09+0.46V_x^2)}$

5. The max displacement of body moving in the water would be:

$$S = \int_0^t V_x \cdot dt = -\int_{1.2}^{V_1} V_x \cdot \frac{dV_x}{1.09 + 0.46V_x^2} = \cdots = -\int_{1.2}^{V_1} 0.46 \times \frac{1}{0.42} \times \frac{d(1 + 0.42 \times V_x^2)}{(1 + 0.42 \times V_x^2)}$$

$$= 1.09 \times [\ \ln(1 + 0.42 \times V_1^2) - \ln(1 + 0.42 \times 1.2^2)] = 1.09 \times [\ln(1 + 0.42 \times 2 \times 9.8 \times S_1) - 0.473]$$

6. The minimum depth of pool would be:

$$S = 1.09 \times \ln(1 + 8.23 \times S_1) - 0.52$$

CONCLUSION

If the body height is 48” (1.2 meter), we have:

$$S = 1.09 \times \ln(1 + 8.23 \times S_1) - 0.52$$

1. For 2H: S_1 = 1’ = 0.30 meter, we have the min pool depth:

   S = 0.84 meter = 2.8 feet

2. For 3H: S_1 = 1’9” = 0.53 meter, we have the min pool depth:

   S = 1.31 meter = 4.3 feet

3. For 4H: S_1 = 2’6” = 0.76 meter, we have the min pool depth:

   S = 1.64 meter = 5.4 feet

4. For 5H: S_1 = 3’3” = 1 meter, we have the min pool depth:

   S = 1.89 meter = 6.2 feet

Panel Options	A Minimum Pool Depth
3 High Alt	5'
3 High	6'
4 High Alt	6'
4 High	7'
5 High Alt	8'
5 High	9'
6 High (Kurve Only)	10'

CONCLUSION

If the body height is 78" (1.98 meter), the equation would be:

$$S = 1.78 \times \ln(1 + 5.49 \times S_1) - 0.60$$

1. For 2H: S_1 = 1' = 0.30 meter, we have the min pool depth:

   S = 1.13 meter = 3.7 feet

2. For 3H: S_1 = 1'9" = 0.53 meter, we have the min pool depth:

   S = 1.83 meter = 6.0 feet

3. For 4H: S_1 = 2'6" = 0.76 meter, we have the min pool depth:

   S = 2.32 meter = 7.6 feet

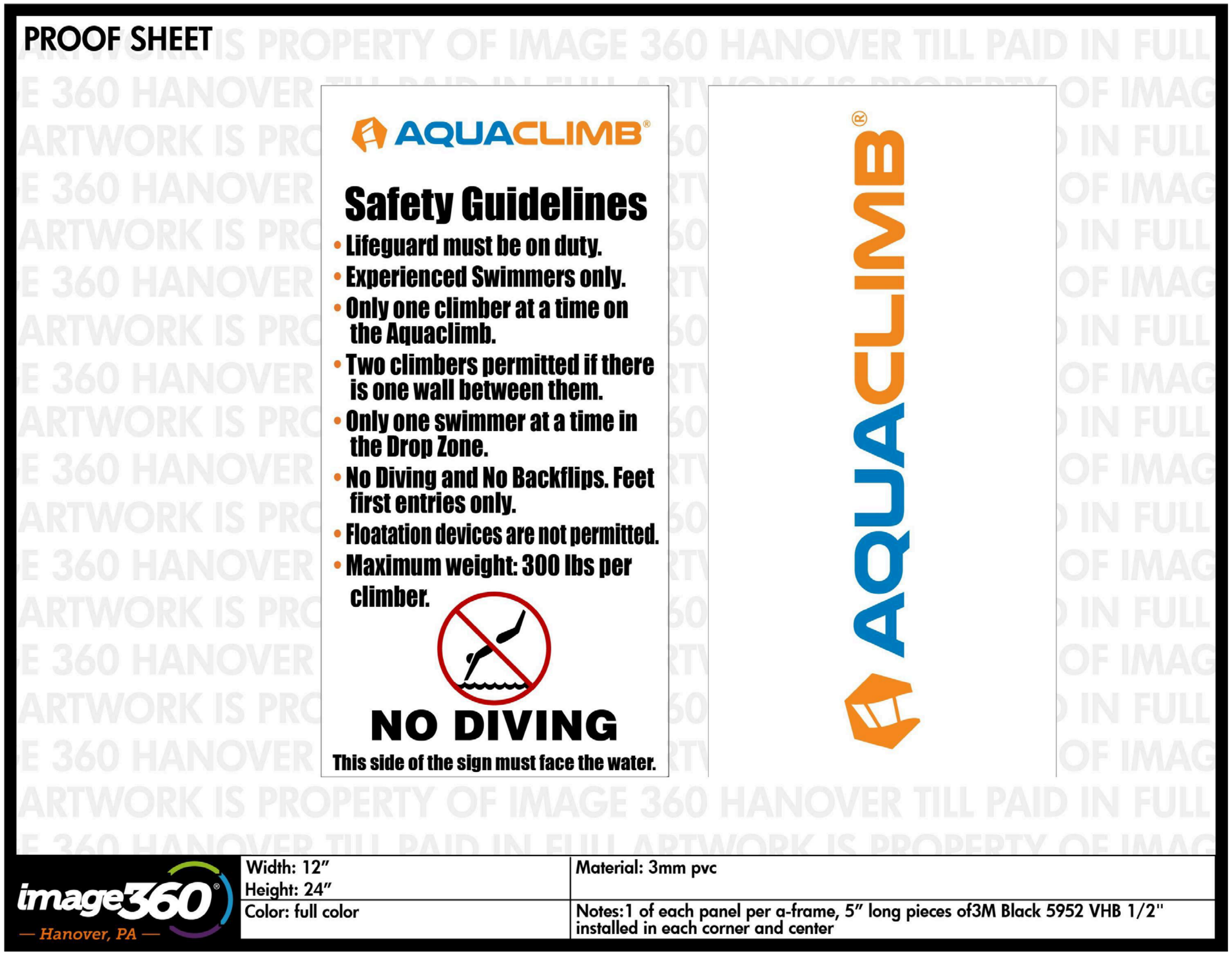
4. For 5H: S_1 = 3'3" = 1 meter, we have the min pool depth:

   S = 2.73 meter = 8.9 feet

Cheney pool depth at climbing walls exceeds this calculation and ranges from 9'-1" to 12'-4 1/2" at the 5H panel drop zones and 8'-4" to 9'-8" at the 5H Alt panel drop zones. The Alt panels do not have hand holds available at the highest points and therefore reduces the water depth minimum because the potential fall height has been reduced.

Panel Options	A Minimum Pool Depth
3 High Alt	5'
3 High	6'
4 High Alt	6'
4 High	7'
5 High Alt	8'
5 High	9'
6 High (Kurve Only)	10'

View proof for Printed PVC Panels for A-Frame

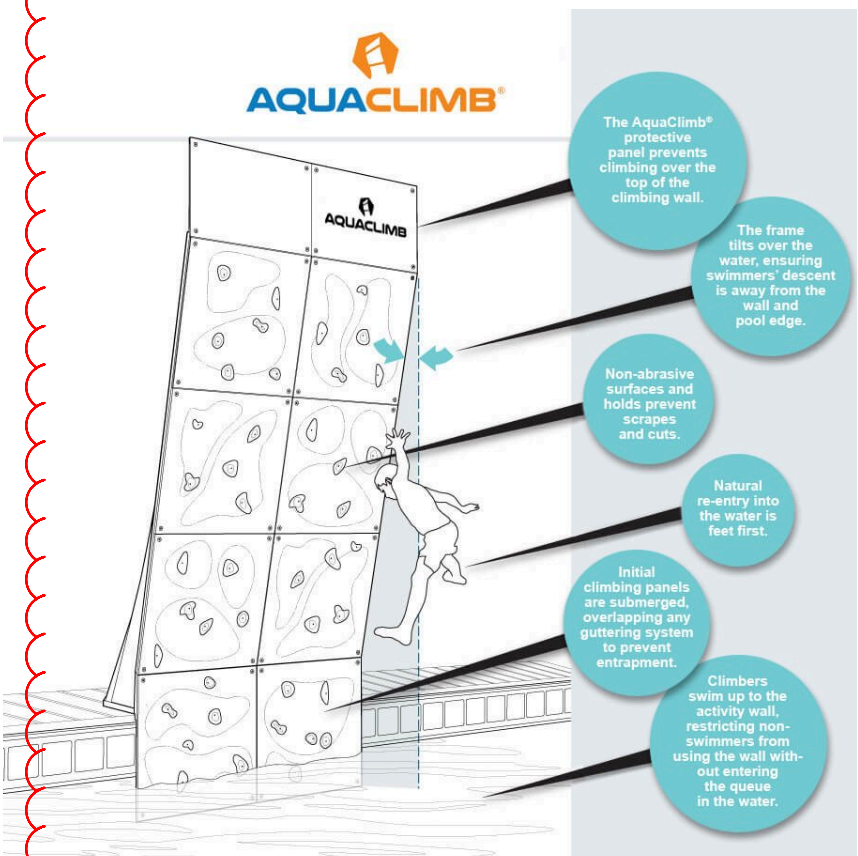


POOLSIDE ADVENTURES™

SAFETY

PROVIDE A SAFE WAY FOR POOL PLAY

AquaClimb® walls aren't just a fantastic poolside attraction. They're a safe way to play. They are specifically designed to eliminate the dangerous situations that can cause injury when sliding and diving. AquaClimb® is a safer alternative to diving boards and slides for both children and adults. Trust the brand that prioritizes you well being!



A SAFE WAY TO PLAY

- Each AquaClimb® comes complete with guidelines for safe use.
- AquaClimb® has clear protective panels to prevent climbers from climbing over the top of the wall.
- The AquaClimb® frame curves and hangs over the pool so that the natural re-entry into the water is feet first and the descent is away from the pool wall and edge.
- Non-abrasive surfaces and holds prevent scrapes and cuts.
- Natural re-entry into the water is feet first.
- Initial AquaClimb® climbing panels are submerged, overlapping any guttering system to prevent entrapment.
- Climbers swim up to the AquaClimb® activity wall, restricting non-swimmers from using the wall without entering the queue in the water.

Poolside Adventures products are recommended by the Aquatic Safety Research Group (ASRG) and are approved by state and

MEET OUR SAFETY TEAM

DR. TOM GRIFFITHS

Dr. Tom Griffiths is the President and Founder of Aquatic Safety Research Group, LLC. Recognized as an international leader in water safety, he has spent 38 years teaching, coaching and managing aquatics at three major universities. Griffiths has produced videos, textbooks, articles, and presentations in local health departments throughout the USA, in addition to major health and safety organizations like PlaySafe LLC, a member of the International Play Equipment Manufacturers Association.

AquaClimbs are designed and engineered to the following standards:

- AISC Manual of Steel Construction, 15 th Edition, ASD
- IBC 2018
- ASCE/SEI 7-16
- ASTM F24/F2291- 21- Standard Practice for Design of Amusement Rides and Devices
- ASTM F2461-20 Aquatic Play Equipment
- European Standards EN17164 – Climbing Walls for Use in the Water Area

AquaZip'Ns are designed and engineered to the following standards:

- ASTM F2291-18 Amusement Rides and Devices
- ASTM F2461-18 Aquatic Play Equipment

CHECK OUT THESE ARTICLES ON THE BENEFITS OF ROCK CLIMBING FOR KIDS!

various areas of aquatics focusing his efforts on safety. He has also conducted hundreds of aquatic facility and beach inspections across the nation and abroad and teaches full day Aquatic Risk Management seminars. Perhaps his most significant contributions are the Five Minute Scanning Strategy©, Griff's Guard Stations©, Disappearing Dummies, his research on Shallow Water Blackout, and the National Note & Float program. He has been an aquatic safety expert for more than 40 years and shares his knowledge, expertise, and experience worldwide. Griffiths just released the 3rd

Why Rock Climbing is Such an Awesome Activity For Kids

5 Mental Health Benefits of Rock Climbing

Poolside Adventures stands on a history of providing a safe climbing experience. The recommended rules provided on our signage and advised during the sales and acquisition process are extremely important to operating a safe and fun activity for all.

We have recently viewed four YouTube videos which show our walls not being properly supervised, having the safe operation signage being displayed at the wall and the wall itself being used in a potentially unsafe manner. Though no accidents have been reported we strongly ask that all facilities please review the safe operation signage with staff and follow our guidelines.

Thank you!

edition of the popular The Complete Swimming Pool Reference.

Read Dr. Tom Griffiths 10-Year Review of the AquaClimb (PDF)

RACHEL GRIFFITHS

Rachel Griffiths, M.A. is the Communication Director for Aquatic Safety Research Group. Rachel conducts water safety research to help prevent drowning and provides water safety education to the public. She is also the President of Note and Float Life Jacket Fund,

AQUATIC SAFETY
Research Group

We Take Water Safety Seriously

DATE: April 9, 2015
TO: Laura Grandner
FROM: Dr. Tom Griffiths
RE: AquaClimb

Ten Year Review

As you know, nearly ten years ago, we placed an AquaClimb climbing wall in the diving well on the Penn State University Campus to test and analyze your product. I was pleased to learn how attractive it was to our students, and how it promoted fun and fitness in the pool with a new and exciting activity that was safe.

Since that time, Rachel and I have inspected hundreds of aquatic facilities and discovered that AquaClimb Walls are a safer alternative to many other poolside recreational products, primarily because swimmers do not have to climb a ladder in a wet environment over a concrete swimming pool deck. Because AquaClimb is accessed from the water inside the swimming pool, rather the swimming pool deck, there is very little chance of a child falling and hitting the deck. Further, the AquaClimb is angled out over the water, and as a result it is very improbable, if not impossible, that a child can fall to the deck.

As an expert witness in courts of law, I see many horrific accidents involving diving boards and slides, but I have never heard of an accident of any kind, minor or major, involving an AquaClimb. As we travel around this country and abroad teaching our full day Aquatic Risk Management Seminars, promoting AquaClimb as a safe, fun, and fitness alternative to other pool products is an essential part of our program. As you recall, AquaClimb is particularly valuable as a replacement for diving boards which no longer meet the depth and distance requirement or because of inadequate protective railings. I might also add that I have never seen a pool product installed as quickly in a swimming pool as an AquaClimb. I truly believe in your product and remain available to answer any questions you and others may have concerning AquaClimb Climbing Walls.

1632 Glenwood Circle, State College, PA 16803 **T** 814.883.0058 **F** 814.234.0313 TomGriffiths@AquaticSafetyGroup.com
AquaticSafetyGroup.com

Regards,

T Griffiths

Tom Griffiths
President and Founder
Aquatic Safety Research Group, LLC

Rachel Griffiths

Rachel Griffiths
Communication Director
Aquatic Safety Research Group, LLC

1632 Glenwood Circle, State College, PA 16803 **T** 814.883.0058 **F** 814.234.0313 TomGriffiths@AquaticSafetyGroup.com
AquaticSafetyGroup.com

AQUATIC SAFETY RESEARCH GROUP, LLC
CONSULTING, TRAINING AND EXPERT WITNESS SERVICES

I. INTRODUCTION

The AquaClimb is an exciting new recreational and fitness component that offers new programming opportunities to aquatic facilities. Because the AquaClimb extends below the surface of the water, participants can easily swim up to the climbing wall and begin to traverse it without leaving the pool itself. Even those individuals without use of their legs can utilize the AquaClimb to exercise the upper body in a fun, challenging, and non-threatening way. Perhaps the most meritorious application of the AquaClimb is an alternative to a diving board in a swimming pool which no longer meets safe diving depth and distance requirements.

Climbers who fall from the AquaClimb will enter the water feet-first. To enter the water head-first from the climbing wall structure is almost a biomechanical impossibility. Prior to purchasing and installing an AquaClimb, aquatic facilities should contact their local regulatory agency (e.g. Health Department) to determine whether regulations, recommendations or suggestions regarding the safe installation and use of the AquaClimb exist. **AQUATIC SAFETY RESEARCH GROUP, LLC**, an independent and objective water safety consultant firm, remains available to assist facilities in answering questions concerning the safe use of the AquaClimb.

II. STANDARD OPERATING PROCEDURES

A. LIFEGUARDS

Whenever the AquaClimb is in use, it is recommended that a properly trained and certified lifeguard be assigned exclusively to the AquaClimb. The lifeguard should be strategically placed to supervise and control use of the structure and to minimize climber misbehavior. Because the apparatus will be positioned in deep water, a lifeguard with deep water skills and qualifications is needed. This lifeguard must also be trained for the proper use and monitoring of the in-water climbing structure. The lifeguard should be positioned close to the wall with a full and unobstructed view of the climbing wall and drop zone, with the ability to see underwater in the drop zone. The lifeguard must stay focused on the climbing wall whenever in use and attention should not be diverted to other areas of the pool. Lifeguard orientations, in-service trainings and emergency action plans should include the AquaClimb and should be reviewed and practiced regularly but at least monthly. In many pools, the best vantage point for proper surveillance may be directly across the pool facing the wall. However, each facility should determine where to best position supervisory staff to ensure a full and unobstructed view of the climbing wall and the drop zone.

The aquatic facility should also establish an entrance and exit pattern (left to right and right to left) to avoid congestion of swimmers waiting to swim into the drop zone to begin their ascent on the wall. This pattern can be changed daily or hourly. For larger installations allowing two or more climbers, additional safety precautions must be implemented to minimize the risk of a climber falling onto someone swimming into or out of the drop zone. One such approach is to direct climbers, once they have fallen from the wall, to swim to the closest edge of the drop zone so as to avoid swimming underneath a second climber.

B. DEPTH REQUIREMENTS

While most competitive swim agencies, including the National Collegiate Athletic Association (NCAA), require a minimum water depth of five (5) feet to dive headfirst from starting platforms, the AquaClimb, which promotes only feet-first entries, takes a more conservative approach, requiring a minimum water depth of five (5) feet for installation of its shortest three-panel wall. As panels are added vertically to the structure, minimum water depth requirements increase. To ensure safety of climbers, AquaClimb has applied commonly accepted safe head-first diving depths to feet-first entries from the structure.

We recognize that these depths are very conservative given that they are intended to minimize the risk of injury from head-first entries rather than from feet-first entries, but absent additional research we cannot safely recommend alternative water depths which deviate from these nationally-accepted standards.

MINIMUM DEPTH REQUIREMENTS FOR AQUACLIMB INSTALLATION			
Panel Height* - standard	3 panels (lowered)	4 panels (lowered)	5 panels (lowered)
Minimum Water Depth	5 feet	7 feet	8 feet

* Each panel measures approximately $3ft^2$ or $1m^2$

MINIMUM DEPTH REQUIREMENTS FOR AQUACLIMB INSTALLATION			
Panel Height* - standard	3 panels	4 panels	5 panels
Minimum Water Depth	6 feet	8 feet	9 feet

C. DECK CLEARANCES

Whenever possible, four feet of deck space should be maintained between the end of the support structure and the perimeter pool wall or fence. If less than four feet is available, a combination of pedestrian control stanchions and traffic cones should be used to direct patrons around the support system. To best accommodate persons with disabilities, a minimum of three feet (36") clearance around the support structures should be maintained. Even with spacious decks, stanchions and cones always come highly recommended, as they minimize the risk of someone coming into contact with the structure. Customers are advised to check building and fire codes to determine whether support structures can permissibly block access to the pool deck, particularly in cases where the support structure would come within three feet of a wall.

D. NUMBER OF CLIMBERS

With a one panel or two panel wide AquaClimb, it is ***highly recommended*** that only one climber use the AquaClimb at a time. With a three panel or wider AquaClimb, however, there is an opportunity to allow more than one climber on the wall at the same time. Multiple climbers should only be allowed when there is no possibility of one climber either interfering with or falling on top of another climber. Multiple climbers should be instructed to climb the wall vertically rather than to traverse the wall horizontally. Climbers should also maintain a distance of at least one panel from other climbers to minimize the risk of climber interference, horseplay and accidental concurrent falls.

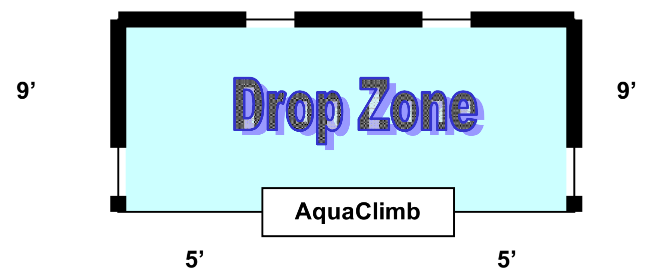
E. VERIFIED SWIMMERS ONLY

Because the AquaClimb is installed in deep water (see minimum depth requirements above), this climbing attraction is to be used only by "swimmers" – persons with verified swimming ability. The attractive colors and the fun activity that the structure provides, are likely to draw younger, weaker swimmers to the climbing wall. These persons should be properly screened to ensure they possess the requisite deep-water skills necessary for using the structure. Following standard aquatic safety practices, anyone wishing to enter deep water to use the AquaClimb should be given a swim test. A recommended swim test would be to have the swimmer/climber jump into ***chest-deep*** water, surface, swim the equivalent length of the buffer zone and return to the starting point. Requiring climbers to tread water for 30 – 60 seconds comes highly recommended. Swim tests should be conducted in chest-deep water to maximize swimmer safety.

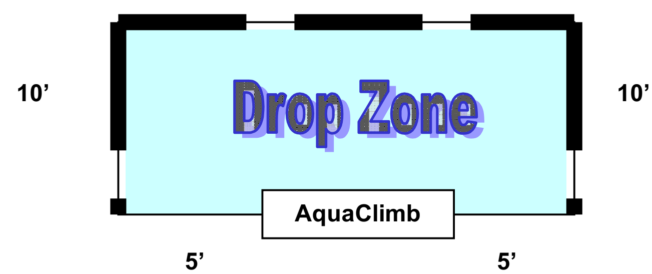
F. DROP ZONE

Climbers will fall from the wall into the water. It is therefore imperative to keep people from entering the "drop zone" where they would risk being struck by a falling climber. No other swimmers should be allowed into the drop zone when a climber is on the wall.

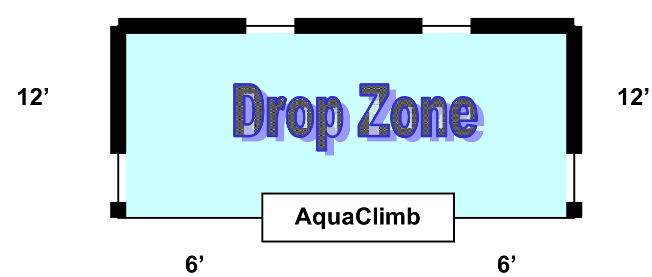
3 panel high:



4 panel high:



5 panel high:



G. FEET-FIRST ENTRIES ONLY

While head-first entries, including dives, are improbable to perform from the face of the climbing wall, and although the depth requirements for the various climbing wall configurations are extremely safe and tend to be conservative, climbers must be warned that all entries into the water from the AquaClimb should be feet-first. Climbers who intentionally violate this safety rule should be prohibited from using the AquaClimb.

H. UNDERWATER ACTIVITIES

Participants should not be allowed to play with the structure itself, particularly while submerged. While there are no hidden hazards or entrapment potentials inherent in the AquaClimb, it is intended for above-water use. It is not intended or designed for underwater use by climbers. Playing underwater around the structure makes it more difficult for the lifeguard to properly supervise the activity. This could lead to injury should a climber fall onto someone who was playing underwater in the drop zone.

III. SUGGESTIONS FOR SAFETY SIGNAGE

Perhaps the most appropriate place to place caution/warning signs would be on the side. The three most important warnings should include:

- "Swimmers Only"
- "No Head First Entries"
- "Only One Climber at a Time unless there are 1-2 clear panel between climbers"

These three warnings can be placed together on the same sign in the appropriate colors (red/white, black/yellow, orange/black). Additional signs/warnings may be mounted on the rear of the support structure.

ASTM F2291-18 & ASTM F2461-18 STAMPED REVIEW

AQUACLIMB CLIMBING WALL

Project: Park Department
City of Decatur, Illinois

FRAMING AND COMPONENT DESIGN

ANDREW MICHAEL DOUMA
081-006414
LICENSED
STRUCTURAL
ENGINEER
STATE OF ILLINOIS

3/5/19

Prepared For:
Pyramide USA, Inc.
8 East 2ND Street
Frederick, MD 21701

WBCM PROJECT NO. 19.0056.00
Date: 3/05/19

WBCM
WHITNEY, BAILEY, COX & MAGNANI, LLC
100 Sterling Parkway – Suite 108 Mechanicsburg, PA 17050
MAIN **(717) 691-4708** FAX **(717) 691-4749**

AQUACLIMB CLIMBING WALL

Design Criteria:

Loading:

- **Live Load** = 300lbs MAX Point Load
  Deflection Limit L/360
- Per ASTM F229- Consider Load Combination of Min 34 mph wind plus climber (section attached)
- Wind Load-
  Basic- 100mph
  Reduced for Combination- 35mph
  Exposure = B
  Importance Factor = 0.87
  Kzt = 1.0
  Kd = 0.85

Material:

- Tubes – A304 Stainless Steel, Fy=30 ksi, Fu = 75 ksi
- plates – A304 Stainless Steel, Fy=40 ksi, Fu = 88 ksi
- Bolts - ASTM F593 Type 304 Stainless steel bolts

References:

- AISC Manual of Steel Construction, 13th Edition, ASD
- IBC 2015
- ASCE/SEI 7-05
- ASTM F2291-18 Amusement Rides and Devices
- ASTM F2461-18 Aquatic Play Equipment

Note – Design of panels, hand-holds and anchorage to panel, and panel anchorage to frame is not included in our scope of services

NAC
ARCHITECTURE

Patty Hayes, Board Chair
Washington State Board of Health
PO Box 47990
Olympia, WA 98504-7990

CHENEY AQUATIC CENTER — Variance Letter Date: 2024.06.25

PROJECT IDENTIFICATION: Lap Pool #: SR009200 Leisure Pool #: SR009201

On Behalf of:
Cheney Aquatic Center, City of Cheney

Owner Contact:	Dan Curley	Phone: 509-498-9293
Owner Address:	609 2nd Street	Cheney, WA 99004
Facility Address:	115 North 8th Street (formerly 711 Cedar Street), Cheney, WA 99004	

Owner Representative: Brooke Hanley (NAC Architecture) 509-838-8240

Variance Request Contact:
NAC Architecture: Brooke Hanley Phone: 509-838-8240 Email: bhanley@nacarchitecture.com

Facility Information:
Cheney Aquatic Center - Project includes an outdoor 6-lane 25-yard lap pool & separate leisure pool with zero-entry, spray features, & lazy river. The pool building with locker rooms, lifeguard offices, party room, and mechanical spaces is about 5000sf. The entire facility is lifeguarded and enclosed securely.

Plan Submittal: Drawing Plans have been submitted for review.

Variance Request Citation:
WAC 246-262-160 states *the board may grant a variance from requirements of chapter* ***246-262*** *WAC if, in the sole discretion of the board, data and/or research provides sufficient evidence that the RWCF (attraction, device, equipment, procedure, etc.), will adequately protect public health and safety, as well as water quality.*

Variance Request: Code language related to Diving Envelope (WAC 246-262-010(21) & WAC 246-262-060(5)(vi)) for the **AquaZip'N Rope Swing** attraction.

Items noted in review letter include:

- **Aqua Zip'N Rope swing** attraction receiving pool shall conform to the CNCA or FINA standards (depth application and setbacks)

In the Spokane Regional Health District review response issued by Steve Main dated May 24, 2024, Steve requests NAC Architecture (NAC) and WaterTechnology, Inc. (WTI) address important concerns regarding public safety related to the receiving pool for the proposed **AquaZip'N Rope Swing** attraction in Pool B.

The concern is to address the minimum depth of the pool to be compliant with the WAC 246-262-010(21) & WAC 246-262-060(5)(c)(vi) regarding diving envelopes for features where users enter the water from above the water surface.

On behalf of the City of Cheney; NAC & WTI respectfully requests your consideration of the current pool depth design at the **rope swing** for the future Aquatic Center. To support this request we provide the attached information, engineering exhibits, and following commentary:

- The review letter states that the "diving envelope" from WAC 246-262-010(21) applies to **all attractions** where users enter above pool water level and therefore requires the CNCA (enter less than 20" above the water surface) or FINA (enter 20" or greater above the water surface) water depths. We submit that the attached engineering calculations for the **AquaZip'N Rope Swing** product will demonstrate that the manufacturer's required water depths and the designed water depths provided at the Cheney Aquatic Center are more than sufficient to protect the safety of the users allowed to participate in this attraction. Calculations were completed for a 72" tall, 250lbs person, any body size smaller than the max would perform better, not worse. The manufacturer's minimum depth requirement is 4 feet. The current Cheney receiving pool water depths exceed the manufacturer's recommendations as it is located in an area that ranges from 6'-8" to 10'-6" deep. Please review the attached data in support of using the manufacturer's depth requirements in lieu of the CNCA diving envelope dimensions.

- WAC 246-262-060(5)(c)(vi) appears to apply specifically to "diving envelopes in pools or areas of pools designated for diving activities". The applicant submits that diving activities are generally defined as plunging into the water headfirst. Diving headfirst into water results in the need for deeper water to avoid a head & neck collision with the pool floor which is different than a feet-first or tucked entry plunge where the body is significantly slowed in the first two feet of water. The **rope swing** safety guidelines (provided in the exhibits) will note that users are required to enter the water in a feet-first manner. Diving from the unit is prohibited. The engineering calculations completed also assume a feet-first plummet into the water.

- The Model Aquatic Health Code also addresses the complexity of "other aquatic features" like this and would suggest that the manufacturer recommendations for design and operation would be adequate to install the feature.

  4.12.10[A] Other Aquatic Features Other AQUATIC FEATURES not otherwise addressed in the CODE, including but not limited to climbing walls, inflatables, and play structures, shall not be installed unless designed and operated in accordance with all manufacturer's installation and operations recommendations.

- 'A-frame' signs with all written safety guidelines will be publicly displayed near the rope swing (see page 12 for example) to meet the criteria of WAC 246-262-070(10). Participants will be screened by lifeguards to ensure they are within the minimum and maximum size requirements.

- See attached rope swing diagrams to understand how the hand holds are provided on the rope at even intervals between 57" and 87" above the deck. The relatively low height of the hand holds does not allow the users to gain much elevation above the water as they slide out over the surface.

- Safety padding rated for falls from 6ft or less are provided around the base of the rope swing structure and down the face of the pool wall to prevent injuries at the corner of the gutter. The rope swing itself has a safety catch, so when the user swings out over the water, they are prevented from sliding back toward the wall. Once the user drops into the pool, the rope self-retracts so the next user does not need to reach out over the water to grab the rope.

- This pool will be lifeguarded at all times while in operation and the lifeguard staff will be the first line of defense to screen bathers to make sure they are experienced swimmers, instruct swimmers on proper use of the attraction, and direct proper swimmer circulation to and from the activity within the pool to avoid congestion or collisions. The **rope swing** will have a dedicated lifeguard to closely supervise the safety of swimmers when the attraction is open for use. Cheney is dedicated to making this facility fun while also as safe as possible for their community members and patrons.

- The **AquaZip'n** has been designed and engineered to meet the following standards:
  - ASTM F2291-18 Amusement Rides and Devices
  - ASTM F2461-18 Aquatic Play Equipment
  - AISC Manual of Steel Construction
  - Other industry standards listed in the product data attached

- NAC submits that the design as described above and substantiated in the attached documentation meets the intent of providing a safe receiving pool for the **AquaZip'N Rope Swing** feature. NAC, WTI, and the City of Cheney respectfully requests a variance accordingly. If the State Board of Health has any follow-up conditions or actions required of the owner/operator, we are committed to reviewing them for implementation.

NAC Architecture (NAC) has teamed with Water Technology (WTI) on numerous aquatic projects and so we have a history of producing these projects successfully. WTI has been designing Aquatic venues for over 40 years. WTI is widely known in the industry as one of the leading aquatic design firms in North America. As one of the industry's leaders, WTI has represented the waterpark industry during CPSC meetings on review of VGB rules and has also been involved in reviewing/editing sections of the MAHC. They are also represented in the Washington DOH committee to update the existing administrative code to adopt a more comprehensive aquatic code like the MAHC. The NAC and WTI commitment to safe aquatic facilities is proven. The design of the receiving pool at the **AquaZip'n Rope Swing** for the Cheney Aquatic Center will not put the health and safety of the public at risk. The City of Cheney, having operated a public pool for many years is experienced and committed to the safety and the welfare of their patrons. On behalf of the City of Cheney, NAC Architecture would like to thank you for your consideration of this Variance Request. Please feel free to contact me with any questions you may have regarding this request.

Thank you,

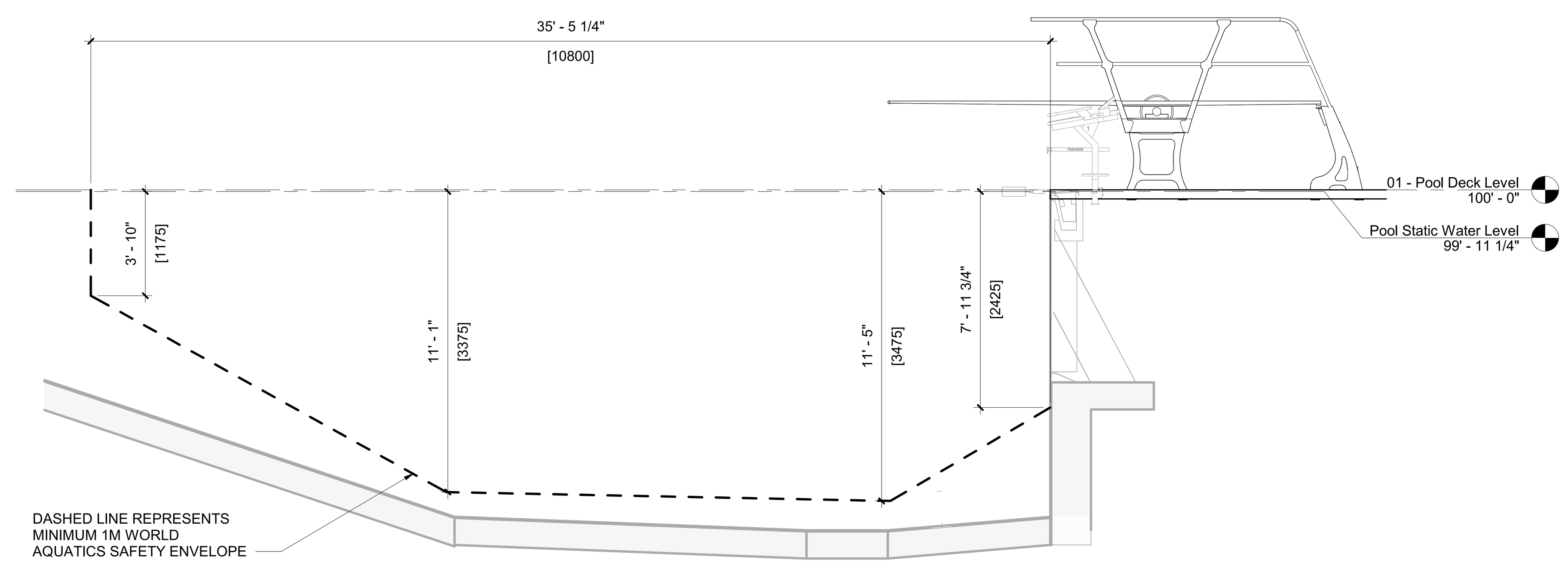
Brooke Hanley

Brooke Hanley, AIA, Principal Architect, NAC Architecture

<u>Attachments</u>:

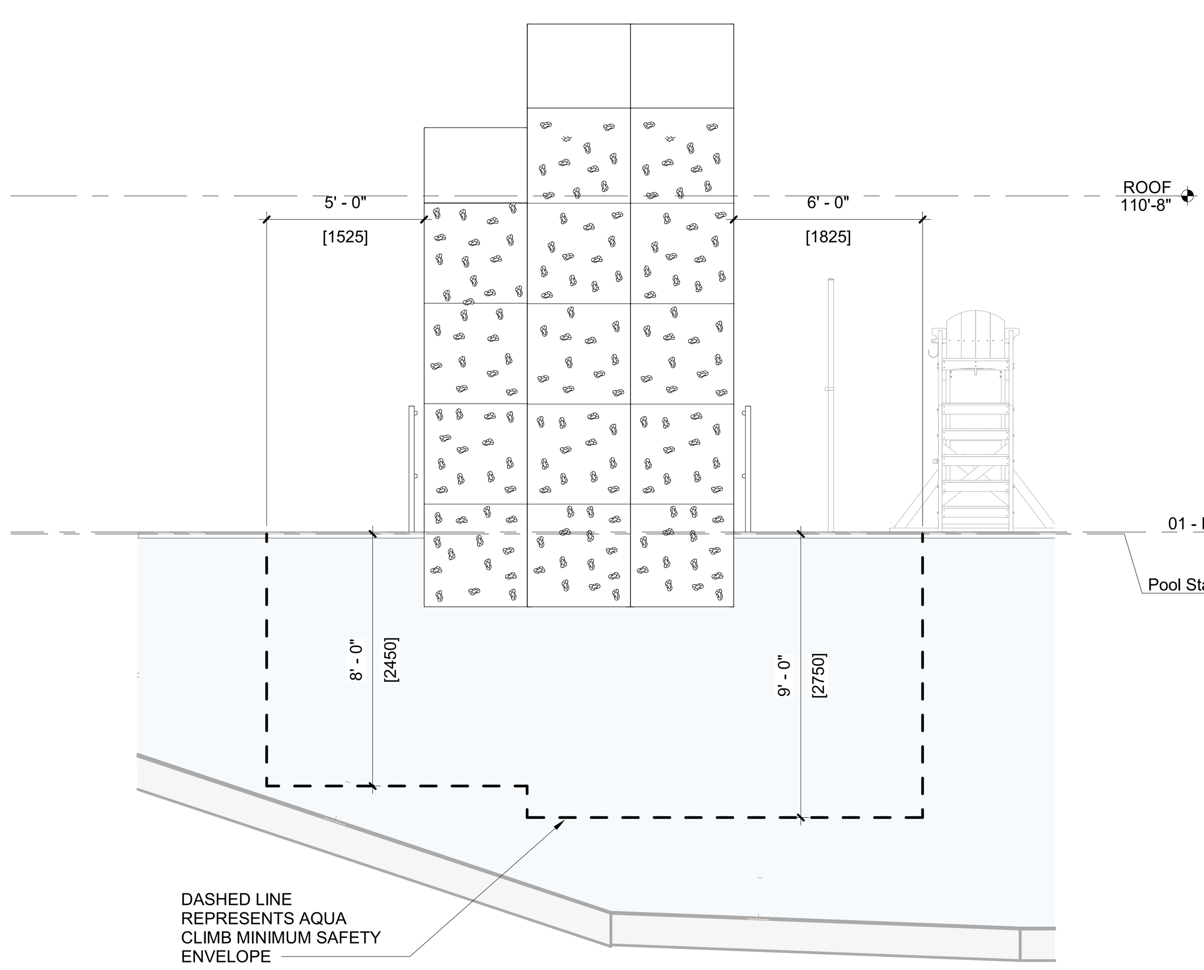
- AquaZip'n Safety Information and Fall Zone Engineering, including a floor plan and section of the receiving pool for the Cheney Aquatic Center.

NOTE:
ALL LANE DIVIDERS AND BACKSTROKE FLAGS MUST
BE REMOVED WHILE DIVING BOARD IS IN USE.



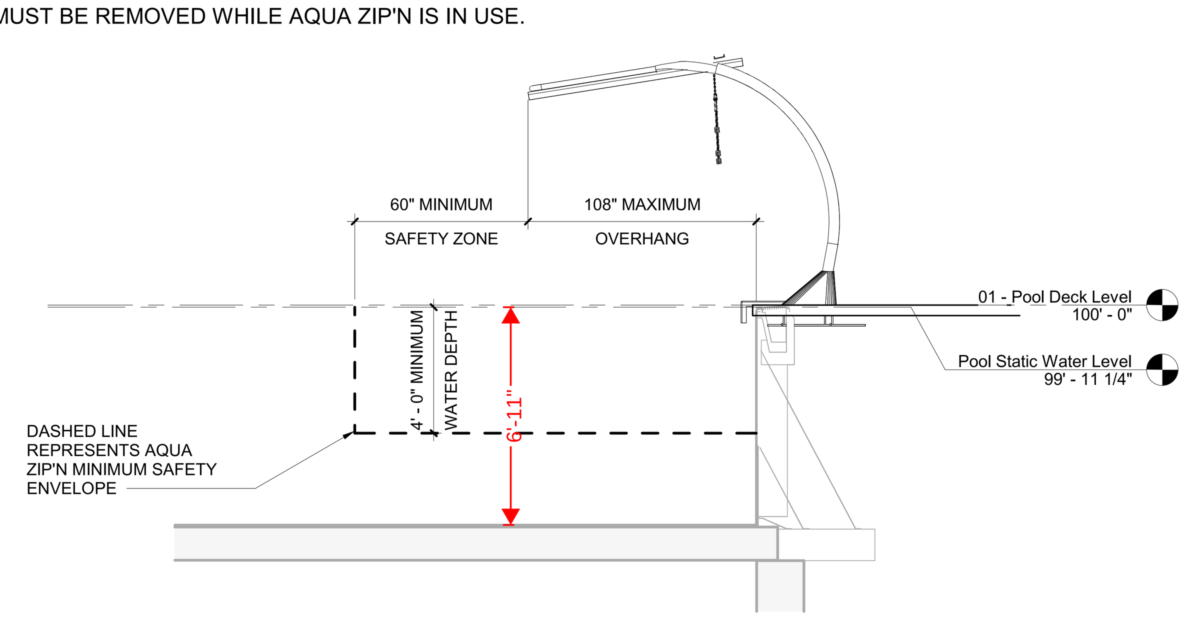
2 PL115 | POOL A - LAP POOL DIVING SAFETY ENVELOPE
SECTION VIEW
1/4" = 1'-0"

NOTE:
ALL LANE DIVIDERS AND BACKSTROKE FLAGS MUST
BE REMOVED WHILE CLIMBING WALLS ARE IN USE.



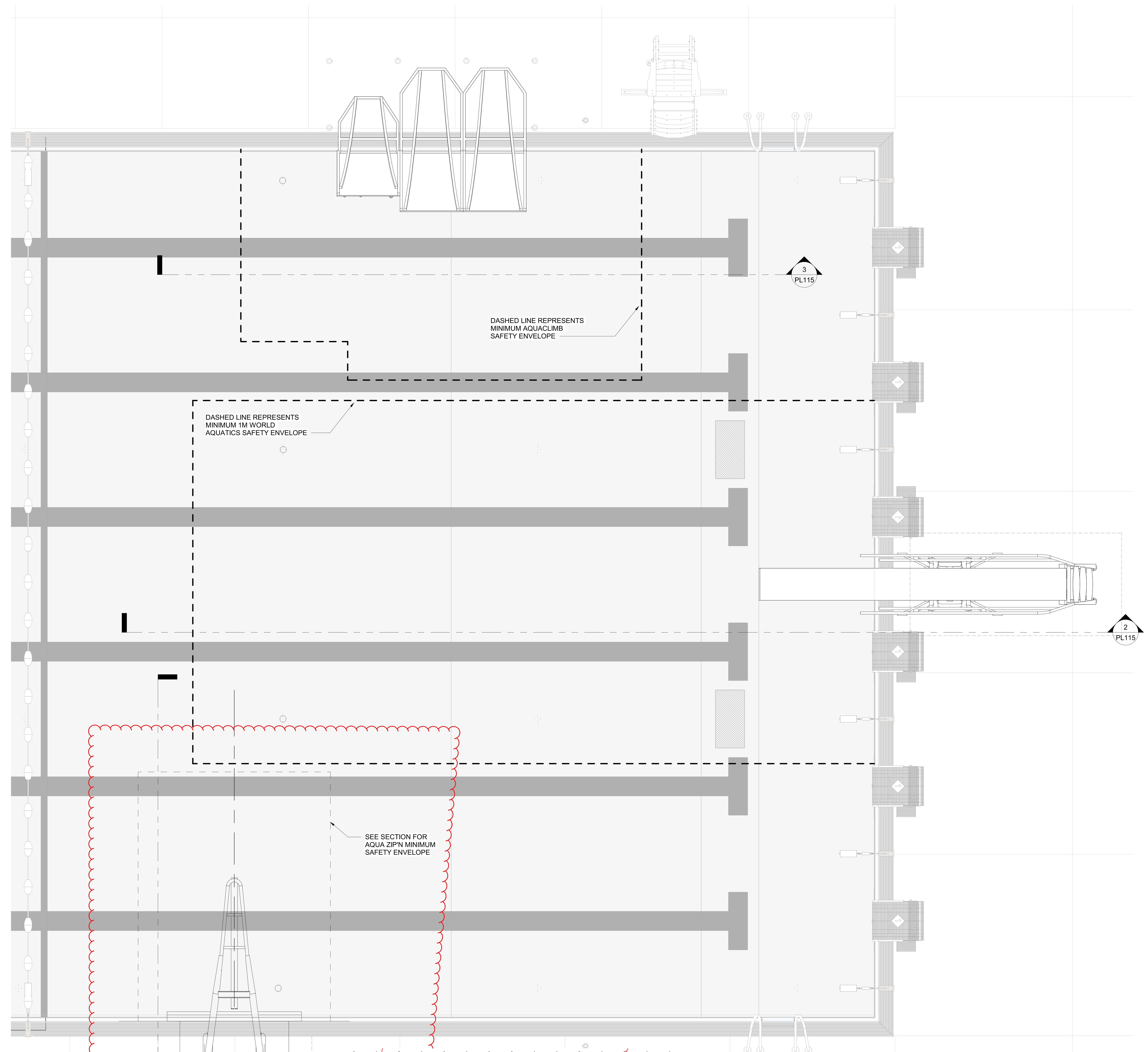
3 PL115 | POOL A - LAP POOL CLIMBING WALL SAFETY ENVELOPE
SECTION VIEW
1/4" = 1'-0"

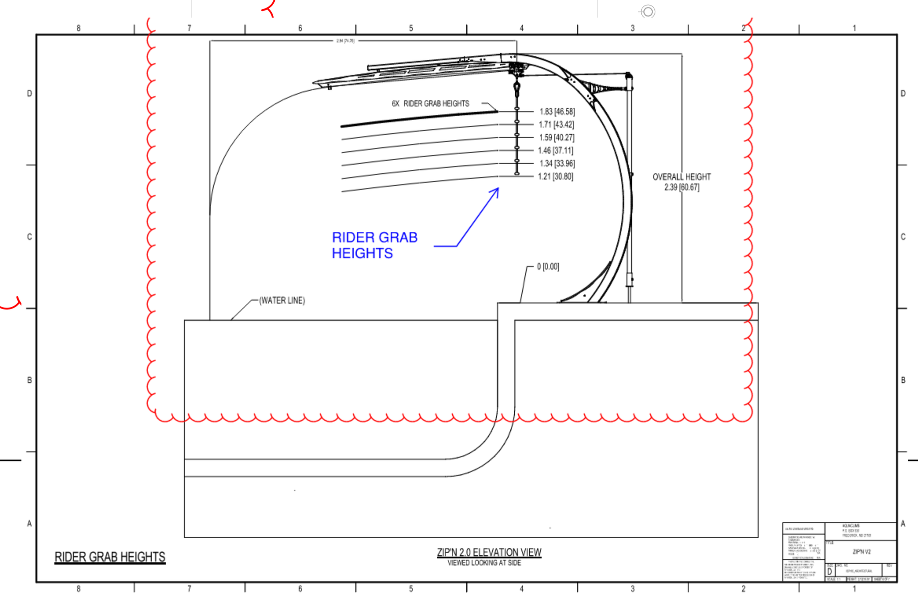
NOTE:
ALL LANE DIVIDERS AND BACKSTROKE FLAGS
MUST BE REMOVED WHILE AQUA ZIP'N IS IN USE.



4 PL115 | POOL A - LAP POOL AQUA ZIP'N SAFETY ENVELOPE
SECTION VIEW
1/4" = 1'-0"

NOTE:
ALL LANE DIVIDERS AND BACKSTROKE FLAGS MUST BE
REMOVED WHILE CLIMBING WALLS, DIVING BOARD AND
AQUA ZIP'N ARE IN USE.





1 PL115 | POOL A - LAP POOL SAFETY ENVELOPES
PLAN VIEW
3/8" = 1'-0"

REVISIONS

BID SET

WATER TECHNOLOGY INC.
World Leaders in Aquatic Planning, Design and Engineering
100 Park Avenue | Beaver Dam, WI 53916
t 920.887.7375 | #23458

CITY OF CHENEY
CHENEY AQUATIC CENTER
711 CEDAR ST. CHENEY, WA 99004

REGISTERED ARCHITECT
MATTHEW W. FRERY
STATE OF WASHINGTON
4/16/2024

NAC ARCHITECTURE
nacarchitecture.com
1203 WEST RIVERSIDE AVE
SPOKANE WA 99201
P:509.838.8240

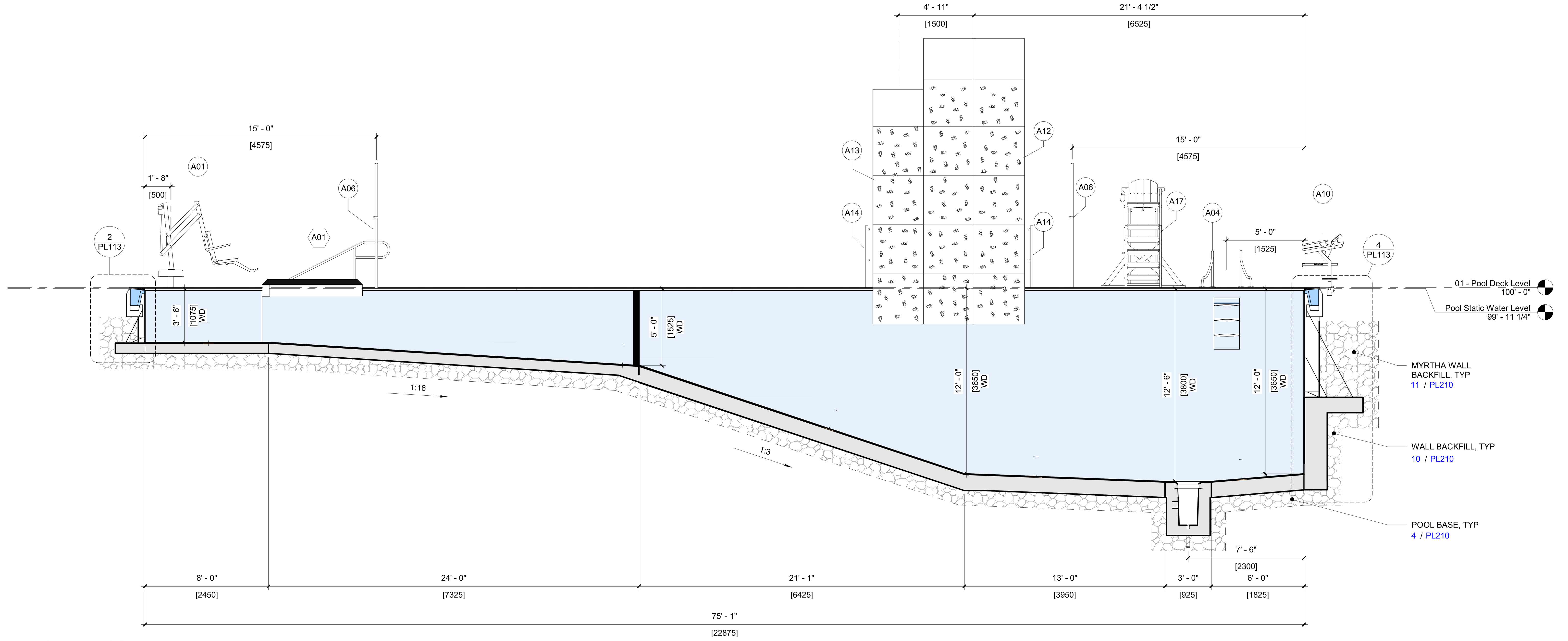
NAC NO	23458
DRAWN	MJC
CHECKED	GGA
DATE	04/16/2024

POOL A - LAP POOL SAFETY ENVELOPES

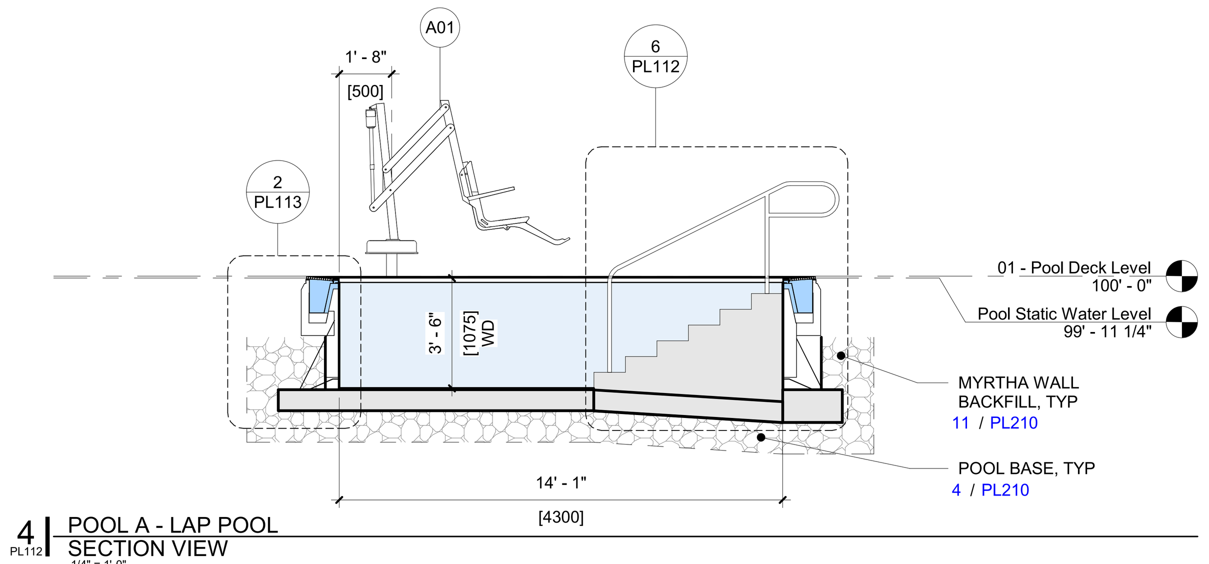
PL115

REVISIONS

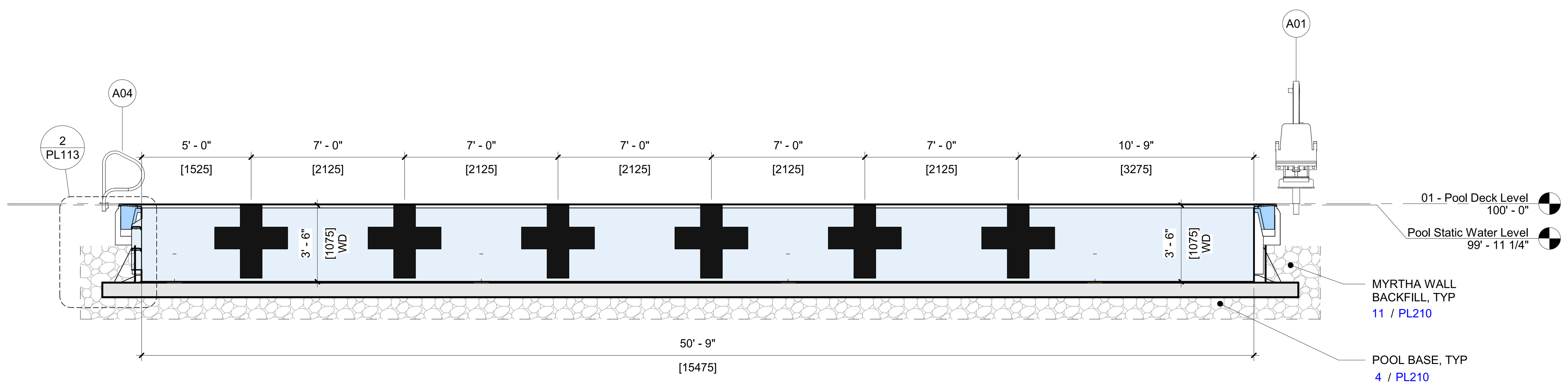
BID SET



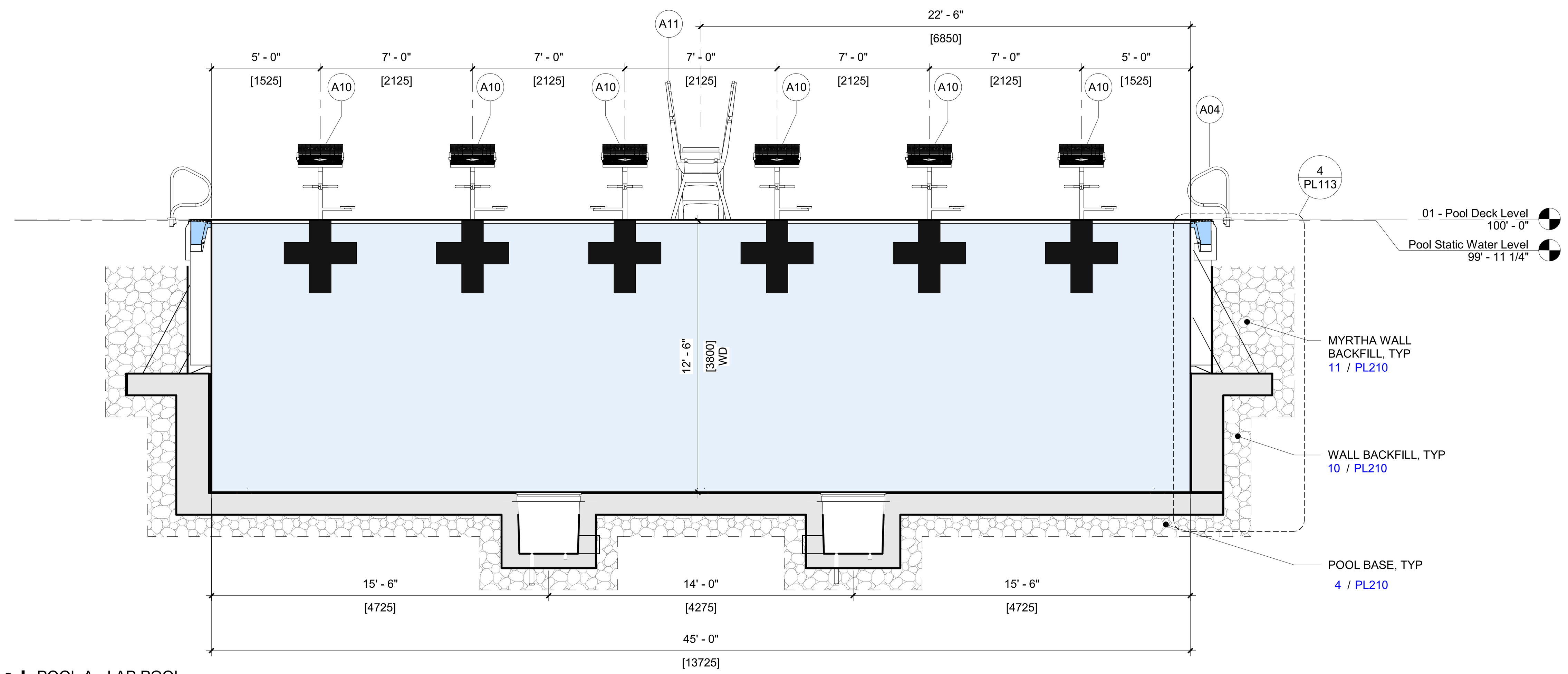
1 POOL A - LAP POOL SECTION VIEW
PL112 1/4" = 1'-0"



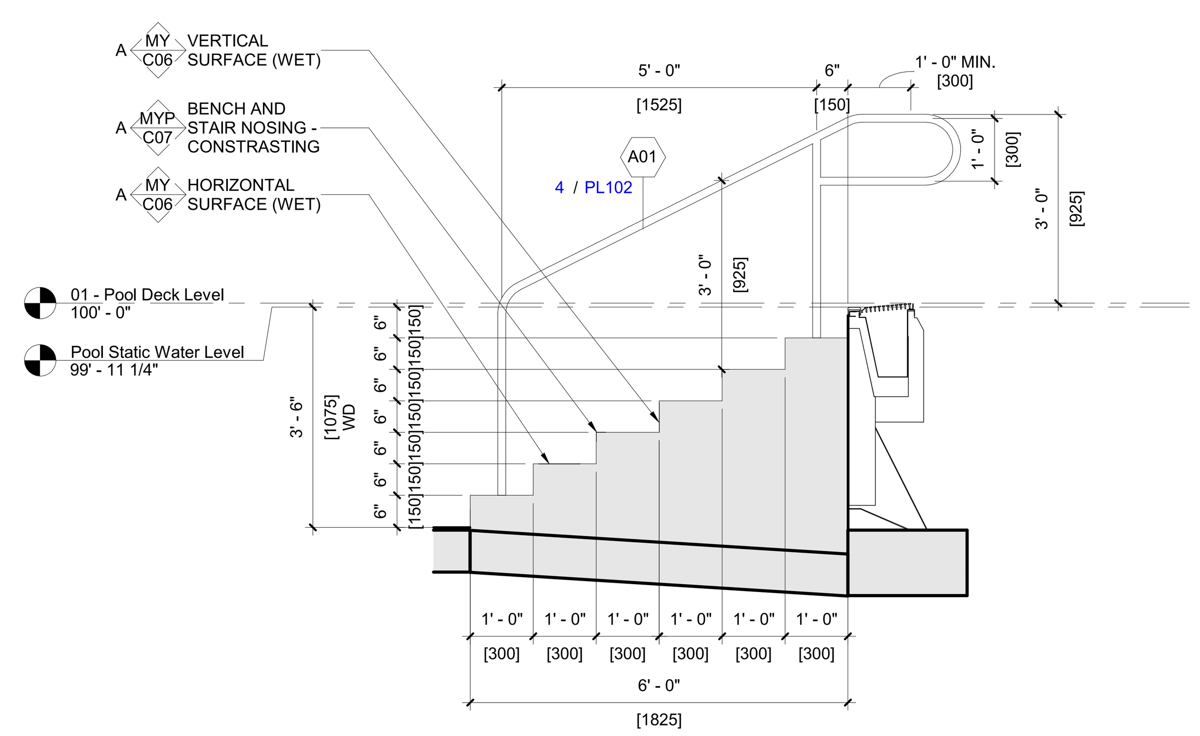
4 POOL A - LAP POOL SECTION VIEW
PL112 1/4" = 1'-0"



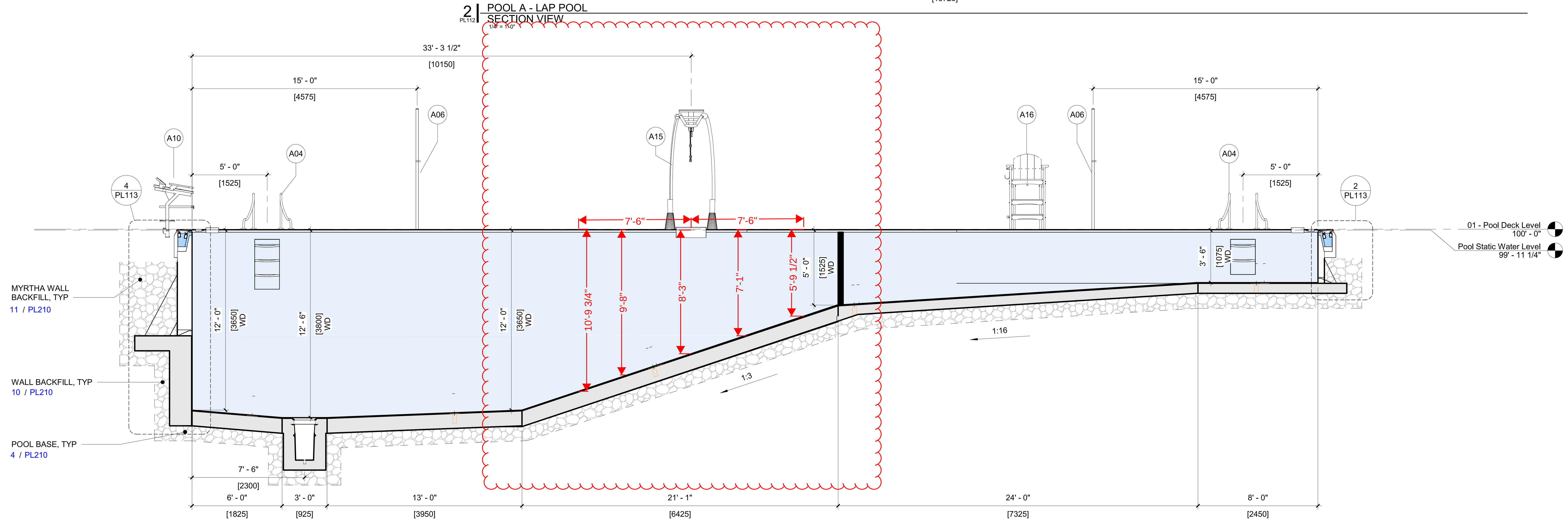
5 POOL A - LAP POOL SECTION VIEW
PL112 1/4" = 1'-0"



2 POOL A - LAP POOL SECTION VIEW
PL112 1/4" = 1'-0"



6 POOL A - LAP POOL STAIRS SECTION VIEW
PL112 1/2" = 1'-0"



3 POOL A - LAP POOL SECTION VIEW
PL112 1/4" = 1'-0"

WTI WATER TECHNOLOGY INC
World Leaders in Aquatic Planning, Design and Engineering
100 Park Avenue | Beaver Dam, WI 53916
920.887.7375 | #23458

CITY OF CHENEY
CHENEY AQUATIC CENTER
711 CEDAR ST. CHENEY, WA 99004

REGISTERED ARCHITECT
MATTHEW W. FRERY
STATE OF WASHINGTON
4/16/2024

NAC ARCHITECTURE
nacarchitecture.com
1203 WEST RIVERSIDE AVE
SPOKANE WA 99201
P:509.838.8240

NAC NO	23458
DRAWN	MJC
CHECKED	GGA
DATE	04/16/2024

POOL A - LAP POOL SECTIONS

PL112

AQUAZIP'N®

Combining the thrill of a zip line with the fun of a rope swing

NEW
Patent Pending
AquaZip'N V3

With only 4 feet of depth required, AquaZip'N® can easily be added as an exciting poolside adventure at:

- Camps
- Country Club
- Colleges/Universities
- Swim Clubs
- Recreation/Aquatic Facilities
- Health/Fitness Centers
- Military Wellness & Recreation
- Private Residences

POOLSIDE ADVENTURES™

PoolsideAdventures.com
800.956.6692
info@poolsideadventures.com

AquaZip'N®: A UNIQUE Poolside Adventure

With nothing like it on the market, AquaZip'N delivers poolside fun and excitement in a fresh new way. With this easy addition to your pool, you will drive demand from guests of all ages and increase your facility's programming capabilities on top of these benefits:

High Throughput

Launching riders into the water quickly, AquaZip'N keeps the line moving with a proprietary self-retracting trolley so kids can experience it again and again.

Position Anywhere

With a minimum water depth requirement of 4 feet, AquaZip'N can be added easily for thrilling poolside adventures in the shallow or deep end.

Minimal Footprint

AquaZip'N requires little deck space with its sleek frame that hangs out over the water and doesn't interfere with normal lap swimming. And with no water source required, it is an easy amenity to add.

Activates the Deep End

As a safer alternative or enhancement to diving boards, AquaZip'N attracts tweens and teens to those under-utilized, deep areas of a pool.

Easy to Install

The AquaZip'N 3-piece system comes pre-fabricated for quick assembly and installation at your facility on any pool gutter configuration.

100% Made in America

AquaZip'N is designed, engineered and manufactured in the USA to conform to all industry standards.

To learn how you can bring the adventure of AquaZip'N® to your facility, contact us today:

POOLSIDE ADVENTURES™

PoolsideAdventures.com | 800.956.6692 | info@PoolsideAdventures.com

Building Courageous Kids for Life's Great Adventure

AQUAZIP'N® SPECIFICATIONS

System Description

Deck mounted, overhead self-retracting pool rope swing. Components consist of Steel support structure, self retracting trolley system with handline. Manufactured off site. Designed to withstand chlorinated environments.

Components

Rope System

Rope system consists of a ⅝", 3-Strand Twisted, High Tenacity Polyester, Plied Yarn. High tenacity for durability, low stretch, superior UV resistance, excellent resistance to acids/chlorines. Attached to the Trolley using high density plastic connector and 3" stainless steel carabiner. See manufacturer's full specification for details.

Support Frame

The support frame shall be fabricated of 304 stainless steel sections powder coated in Glacier White, consisting of multiple bolt-together assemblies. The Frame height is 115" and maximum width of 39" with an overall length of 147" from back of structure to end of track.

Anchors

Anchors are to include either Hilti Chemical Anchors using Hilti HIT-HY 200 Adhesive—⅝" diameter or HAS-R stainless steel wedge anchor (or approved equivalent) with a 3-⅛" minimum embedment, (5qty anchors) per leg. Install anchors per manufacturer instruction.

Fasteners

All fixed connections: Bolts, Flat Washers, Nuts, are attached by grade 18-8 stainless steel or higher. Anchors will be 18-8 Stainless Steel or higher grade.

Trolley Cable Retraction Assembly

³⁄₁₆" Dyneema 12-strand Cable

Warranty

AquaZip'N® is warrantied to the original purchaser to be free from defects in material and workmanship from the date of installation, during normal use and installation, with exclusions of cosmetic defects through wear and tear: Limited 2-Year Warranty

Design Recommendations

Deck & Gutter

The pool deck in the AquaZip'N® installation area should be as level as possible. If the pool has a coping greater than 1-½", or does not meet the standard base concrete requirements below, additional hardware components may be required. Please complete the Poolside Adventures™ Gutter Configuration Worksheet available on our website and contact a Poolside Adventures™ representative to determine the proper installation hardware and anchoring required.

Concrete Requirements

Standard length anchoring system requires a minimum concrete depth of 4" (with 6x6 W2.0 welded wire mesh ASTM A185) with 3000 psi rating or greater, embedded to a minimum depth of 3-⅛". See Hilti anchor requirements for further details. Further concrete requirements for proper installation includes a 4" thick, 6' wide (away from pool edge) of uninterrupted, un-cracked concrete slab section. Length (parallel with pool edge) of concrete slab can vary based on desired maximum rider weight:

- 8' long for 250 lbs rider load rating
- 7' long for 200 lbs rider load rating
- 6' long for 150 lbs rider load rating

Clearances & Safety Recommendations

Please contact a Poolside Adventures™ representative for current product information regarding pool depth and clearance zone recommendations based on the deck and configuration to be installed.

State certified engineered drawings and/or drawings specific to actual site installation details may be required for approval of AquaZip'N® installation. Standard structural engineering drawings are available at no charge. State or site-specific engineered drawings may be an additional cost. Please contact the appropriate local governing department for more information.

Poolside Adventures™ product guides, installation instructions, owner's maintenance guide and other resources are available at www.poolsideadventures.com or can be requested by calling 800-956-6692.

Operations Manual AquaZip'N

The new AquaZip'N design allows for minimal maintenance and high throughput. The following is the inspection checklist.

Daily Checklist:

- Ensure proper trolley retraction by rolling trolley out over water, letting go and watching to see that trolley returns to original starting location.
- Check trolley wheels and bearings visually to ensure trolley is secure within its track.
- Visibly check retraction cable for wear & tear.
- Cable stretch is normal. However, if you notice the weight is contacting the bottom of the baseplate it is time to replace your retraction cable. Call Poolside Adventures at 800-956-6692 to order a replacement.
- Visibly check the rubber bumpers on the front and back of the track to ensure they are firmly in place and there is no visible cracking or imperfections.
- Spray silicone-based lubricant onto all wheel bearings to increase the smoothness and longevity of your trolley system.

Monthly Checklist:

- Inspect trolley to ensure secure attachments of retraction cable to trolley.
- Inspect hand rope for wear & tear.
- Inspect rubber bumpers on the front and back of the track for any cracks or imperfections. If any are found, please call Poolside Adventures at 800-959-6692 to order replacements.
- Check retraction cable for wear & tear.
    - Cable stretch and wear is normal. If you notice any significant wear on your retraction cable or if the weight is contacting the bottom of the baseplate when in operation it is time to replace your retraction cable. Call Poolside Adventures at 800-956-6692 to order a replacement.
- Check all bolts on the AquaZip'N structure to ensure they are firm & tight.
- Be sure acorn nuts are firmly secure on all threads able to be reached from the ground.
- Anchor bolts shall be taught to specifications.
- Inspect safety pad for visible signs of wear including cracks and gouges.

Seasonal/Annual Checklist:

- Remove trolley from track to complete thorough trolley inspection, ensuring all bolts are firm and all wheels and bearings are in good shape.
- Over time the wheels and bearings will need to be replaced. Call Poolside Adventures at 800-956-6692 to order replacement wheels.
- Store trolley indoors, in a cool dry location, during the off-season.
- Inspect concrete surface for cracking and weathering to which the PSI of concrete could become compromised.

"A" FRAME SIGN TO BE DISPLAYED AT ALL TIME THE AQUAZIP'N IS IN USE

Calculation Report

Hand Calculation on Projectile Analysis & Forces on the user

FEAmax LLC. Engineering Design, Analysis & Manufacturing Services.
Email: info@FEAmax.com; *Web*: www.FEAmax.com

5/3/2024

PROJECT INFO.

Change History:

Version Number	Date	Prepared by	Reviewed by	Contact
V 1.0	5/3/2024	Bill Bin	Frank Wang	Frank.Wang@feamax.com

CFD Requestor Info.:

Contact name:	Alex Salzman
Email:	Alex@PoolsideAdventures.com
Company name:	PYRAMIDE USA INC.
Address:	PO Box 530. Frederick, MD 21705

PROJECT DESCRIPTION

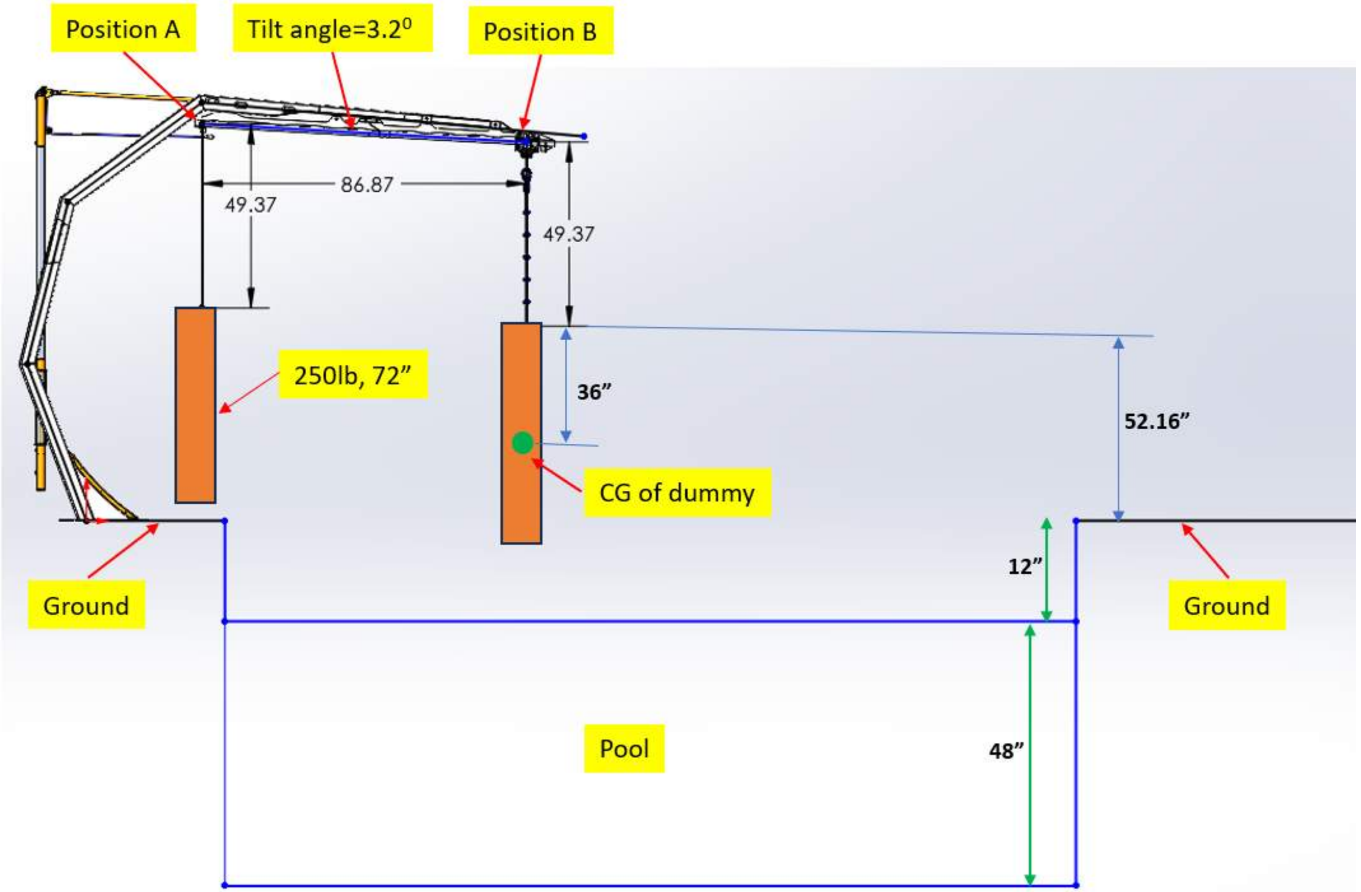
Project Description:

1. Perform hand calculations on the trolley system with the two cases.
2. The case #1 - Projectile Analysis: determine how far and how deep could a user go when launching from starting heights.
3. The case #2 - Forces on the user: determine the force on the user at beginning of ride and the end of ride.
4. The CAD model file for the calculation:
   - *Z0037C_V3.2 Master Assembly.SLDASM*
5. All related documents were received by 4/1/2024

CAD MODEL

CAD Model

1. The CAD model and the dimension information for calculation:



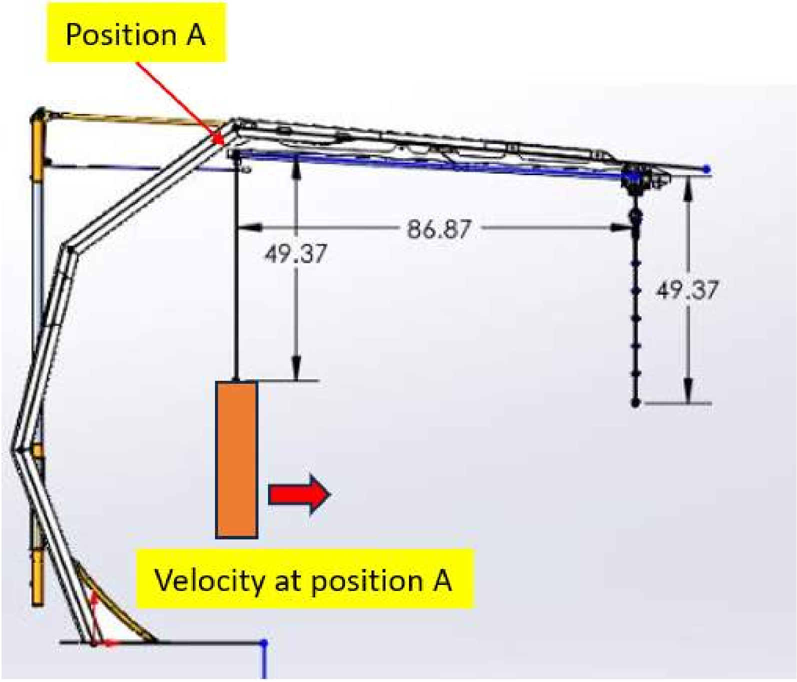
ASSUMPTIONS

Assumptions:

1. Assume a block/dummy on the rope with 250lbs mass and 6 feet height.
2. Assume the max jump forward distance is about 9.8 feet for a 250lbs adult from a standstill (worst case).
3. Considering the ideal condition, the person jumps at 45 degrees.
4. Assume it is frictionless contact at the top track rail.
5. Assume the 6 feet height dummy as a mass point at the CG (center of gravity).

Calculation of initial velocity

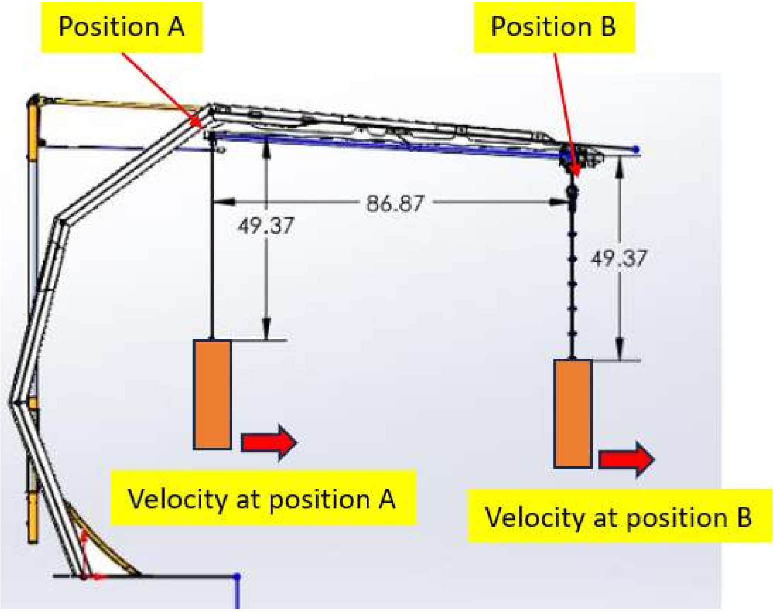
1. Equations:
   - V x T = L
   - V = g x t / 2
   - In which: V is velocity, T is time, L is the length and g is the acceleration.
2. We have V = sqrt(L x g / 2), in which: L= 9.8 ft, g = 32 ft/s2
3. The calculated results:
   - The initial velocity at position A = sqrt(L x g / 2) = 12.56 ft/s



CALCULATION RESULTS

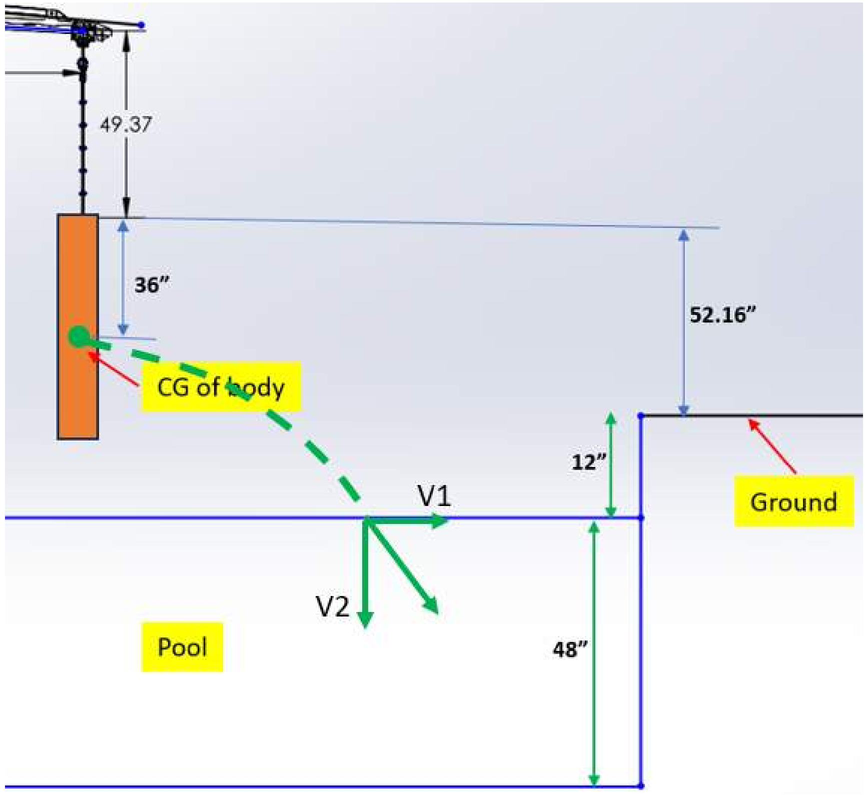
Item#1 – Projectile Analysis

1. Calculation#1 –velocity at position B:
   - Because of the frictionless contact and the tilt angle is only about 3 degrees between position A and B, we could assume the velocity at position B is the same as or very close to position A.
   - The velocity at position B = 12.56 ft/s
2. Calculation#2 – the moving distance before touch the water:
   - The initial horizontal speed V = 12.56 ft/s
   - The height above water (from CG of body to water) = 52.16+12-36 = 28.16 inch
   - The time before touch water t = sqrt(2L /g) = sqrt(2x28.16/32.15) = 0.38 s
   - The vertical velocity V2 = g x t = 12.33 ft/s
   - The horizontal velocity V1 = 12.57 ft/s
   - The moving distance before touch the water L = V1 x t = 4.75 ft



Item#1 – Projectile Analysis

3. Calculation#3 – the moving depth and distance in the water:
   - Equation: $F_d = 1/2 \cdot Cd \cdot \rho \cdot A \cdot v^2$
   - where:
   - F_d is the drag force, C_d is the drag coefficient, ρ is the density of the fluid (water is approximately 1000 kg/m3), A is the cross-sectional area of the object perpendicular to the flow of fluid, v is the velocity of the object relative to the fluid.
   - The drag coefficient (C_d) and the cross-sectional area (A) depend on the shape and orientation of the human body in the water. We'll need to make assumptions to proceed.



CALCULATION RESULTS

Item#1 – Projectile Analysis

4. Calculation#4 – the moving depth and distance in the water:

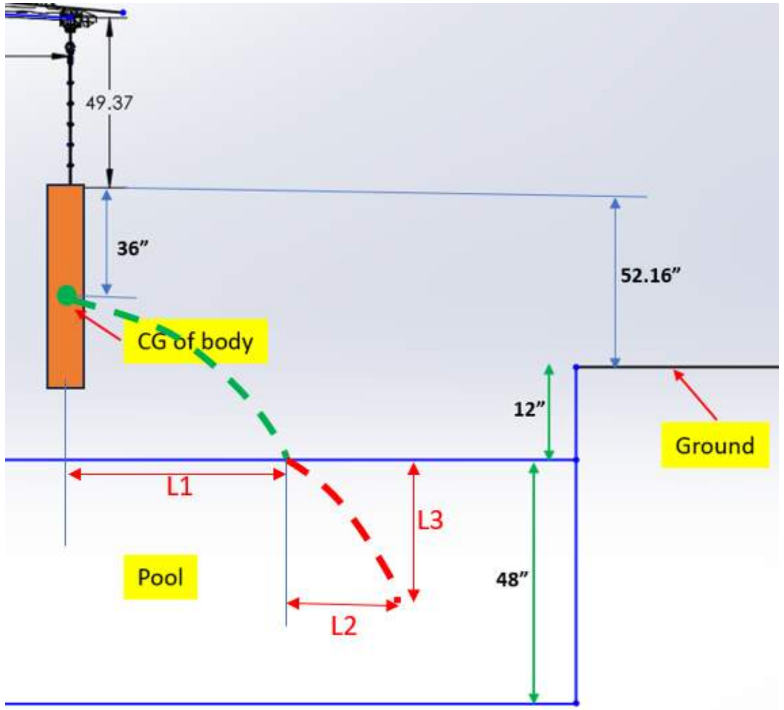
- The depth and horizontal distance can be determined by integrating the motion equations under the influence of gravity and drag. However, the actual calculations can be very complex due to the non-linear drag force that depends on the velocity squared.
- Assume a constant average drag coefficient and ignoring buoyancy for the depth calculation, we can estimate the maximum depth and horizontal distance.
- Assume Cd=1.0 for a body position that is neither perfectly streamlined nor fully perpendicular to the flow. Assume cross-section area A=0.1 m^2, which is a rough estimate for a human body.
- Calculate the maximum depth and horizontal distance by considering the initial kinetic energy and the work done against the drag force. Distance = $\int_{V_i}^{0} \frac{1}{0.5Cd\rho Av} dv$ where v_i is the initial speed in the respective direction.
- The calculated maximum depth and horizontal distance the human can reach in water are approximately 0.84 meters.
- Note: these results are highly simplified. The actual values could differ significantly due to various factors such as the complex nature of drag in fluids, body orientation, and body shape effects.

CALCULATION RESULTS

Item#1 – Projectile Analysis

5. Calculation Results:

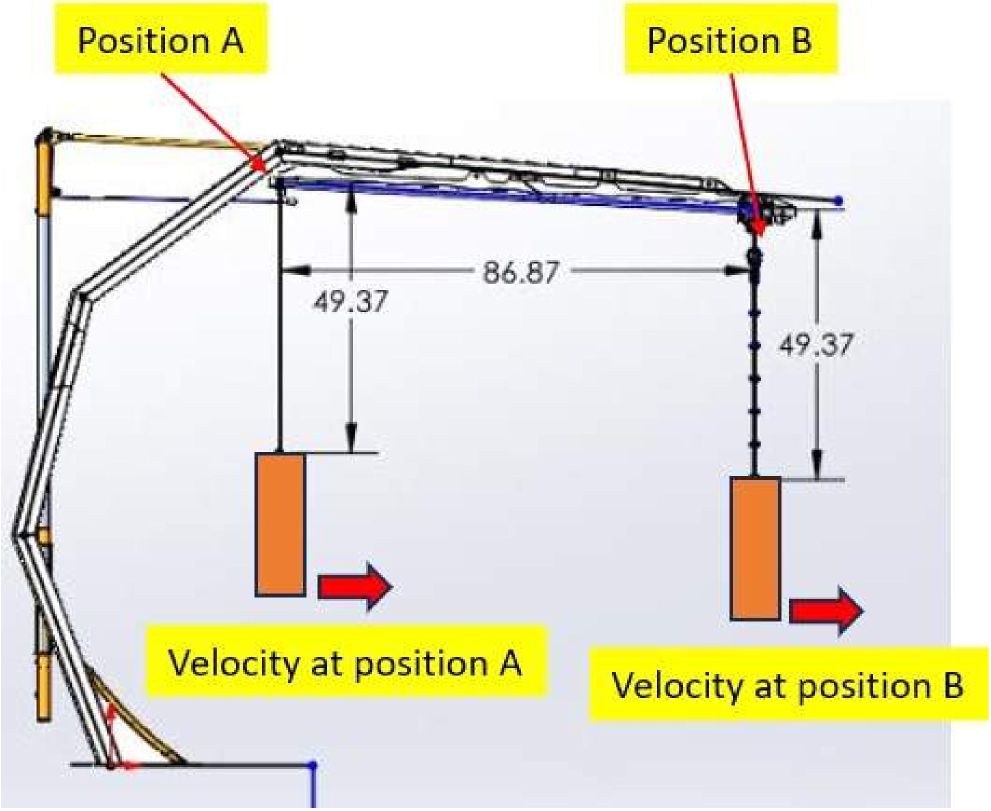
- Before touching the water, the body can move in horizontal direction L1 = 4.75 ft
- The max moving distance in horizontal direction in the water is about L2= 2.76 ft.
- The max depth in the water is about L3 = 2.76 ft.
- Note: if counting the body heigh 6ft, the max depth in the water would be 5.76 ft.



CALCULATION RESULTS

Item#2 – Forces on the user:

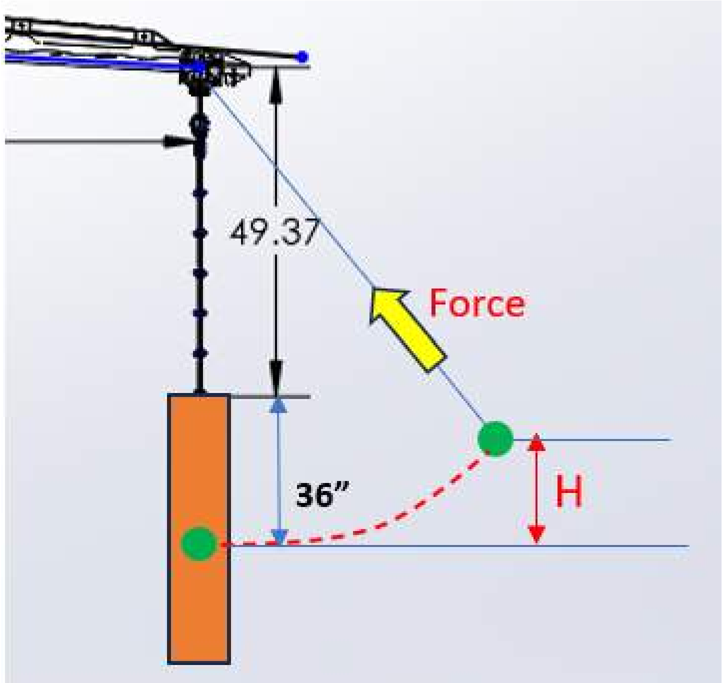
1. Calculation#1 – the max holding force on the user at position A:
   - Assume the body moves in horizontal direction, the initial holding force in vertical direction would be the same as the weight of user.
   - So, the max force on the user from rope at the beginning of ride (position A) is about 250 lbf.



CALCULATION RESULTS

Item#2 – Forces on the user:

2. Calculation#2 – the max holding force on the user at position B:
   - Assume the user would hold the rope without release.
   - The body would swing and cause higher force on the rope.
   - Max force T_{max} = m x g + m x v^2 / r = 422 Lbf.
   - The user swing height is about H = V^2 / 2g = 2.43 ft



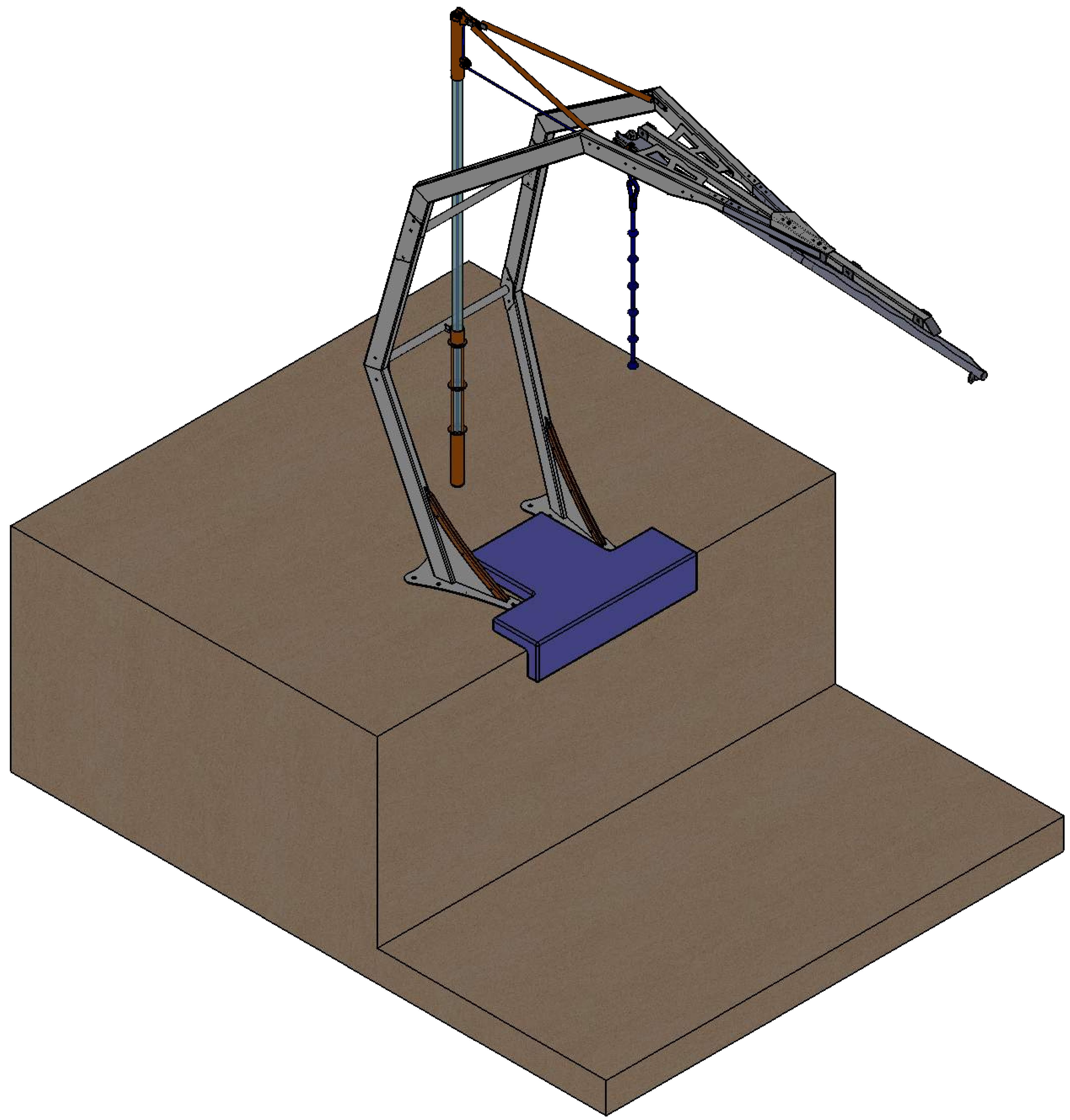
3. Results:
   - The max force on the user (holding force on hands) from rope at the beginning of ride (position A) is about 250 Lbf.
   - The max force on the user (holding force on hands) from rope at the end of ride (position B) is about 422 Lbf.
   - The user can swing upward max height is about 2.43 ft.

REVISIONS			
REV.	DESCRIPTION	DATE	REV'D BY
A	Initial Release	7/27/2023	A. Salzman

<u>Designed and engineered to the following standards:</u>

- ASTM F2291-18 Amusement Rides and Devices
- ASTM F2461-18 Aquatic Play Equipment
- International Building Code (IBC) 2015 and ASCE 7, Minimum Design Loads for Building and Other Structures
- AISC Manual of Steel Contruction, 13th Edition
- ASD and Steel Design Guide 27 - Structural Stainless Steel

***Full structural analysis and stamped fabrication drawings available upon request



DESIGN

POOLSIDE ADVENTURES™

P.O. BOX 530
Frederick, MD 21705

PHONE: +1 800.956.6692
FAX: +1 240.575.6020
EMAIL: info@poolsideadventures.com

AquaZip'n V3.1 Architectural Guide

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FREDERICK, MD 21705

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DIMENSIONS ARE IN INCHES [mm]
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ANGULAR: MACH ± 1 BEND ± 1
TWO PLACE DECIMAL ± .03 [0.76]
THREE PLACE DECIMAL ± .005 [0.127]
DO NOT SCALE DRAWING

	NAME	DATE
DESIGNED		
DRAWN		
CHECKED		
ENGINEERED		

COMMENTS:
-NONE-

PROJECT:

TITLE:

SIZE	DWG. NO.	REV
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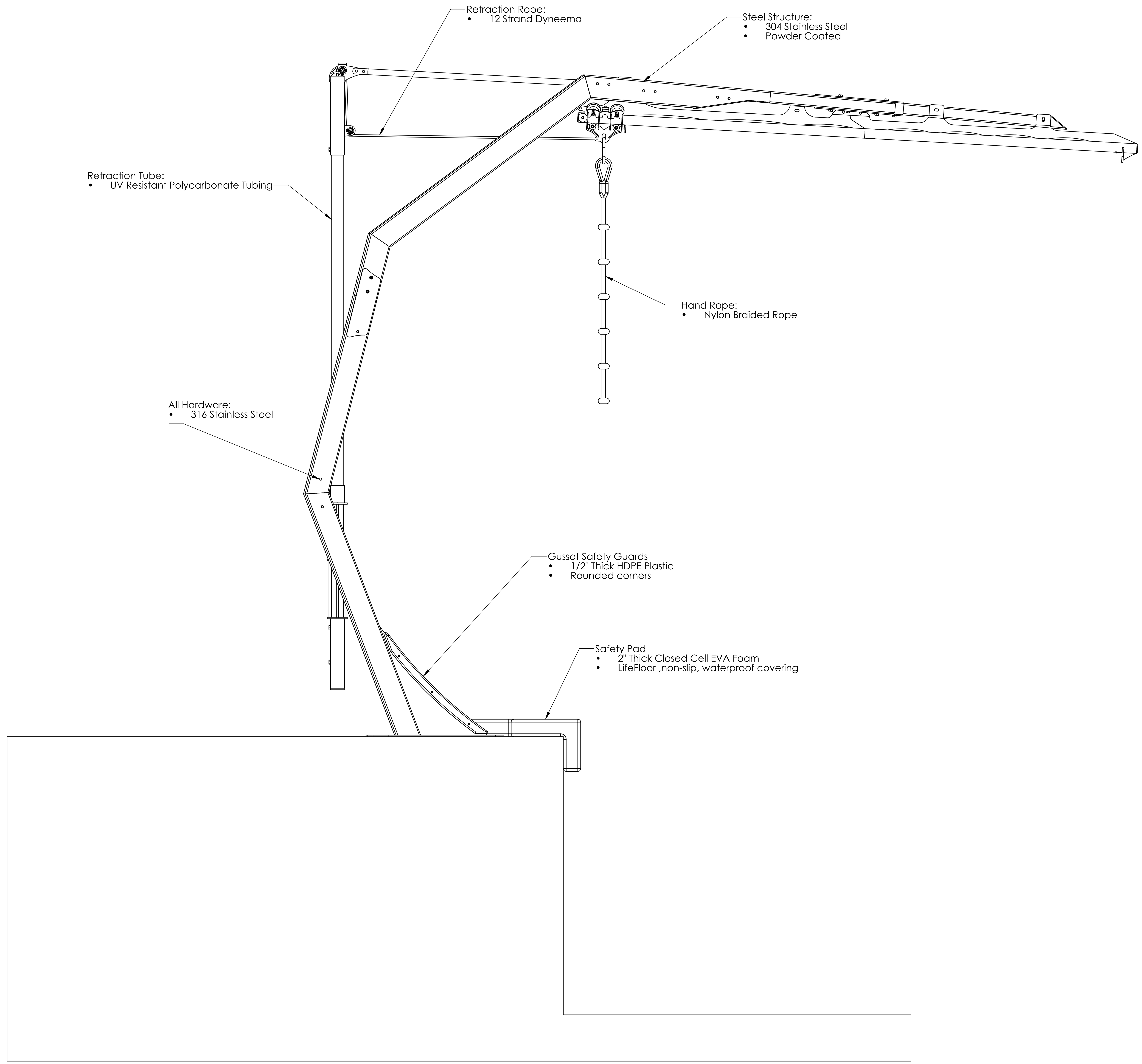
SCALE: 1:24	WEIGHT: 25799.23	SHEET 1 OF 7



Material Specs

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THREE PLACE DECIMAL ± .005 [0.127]
WELDS: $^{+1/16}_{-0}$

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SIZE	DWG. NO.	REV
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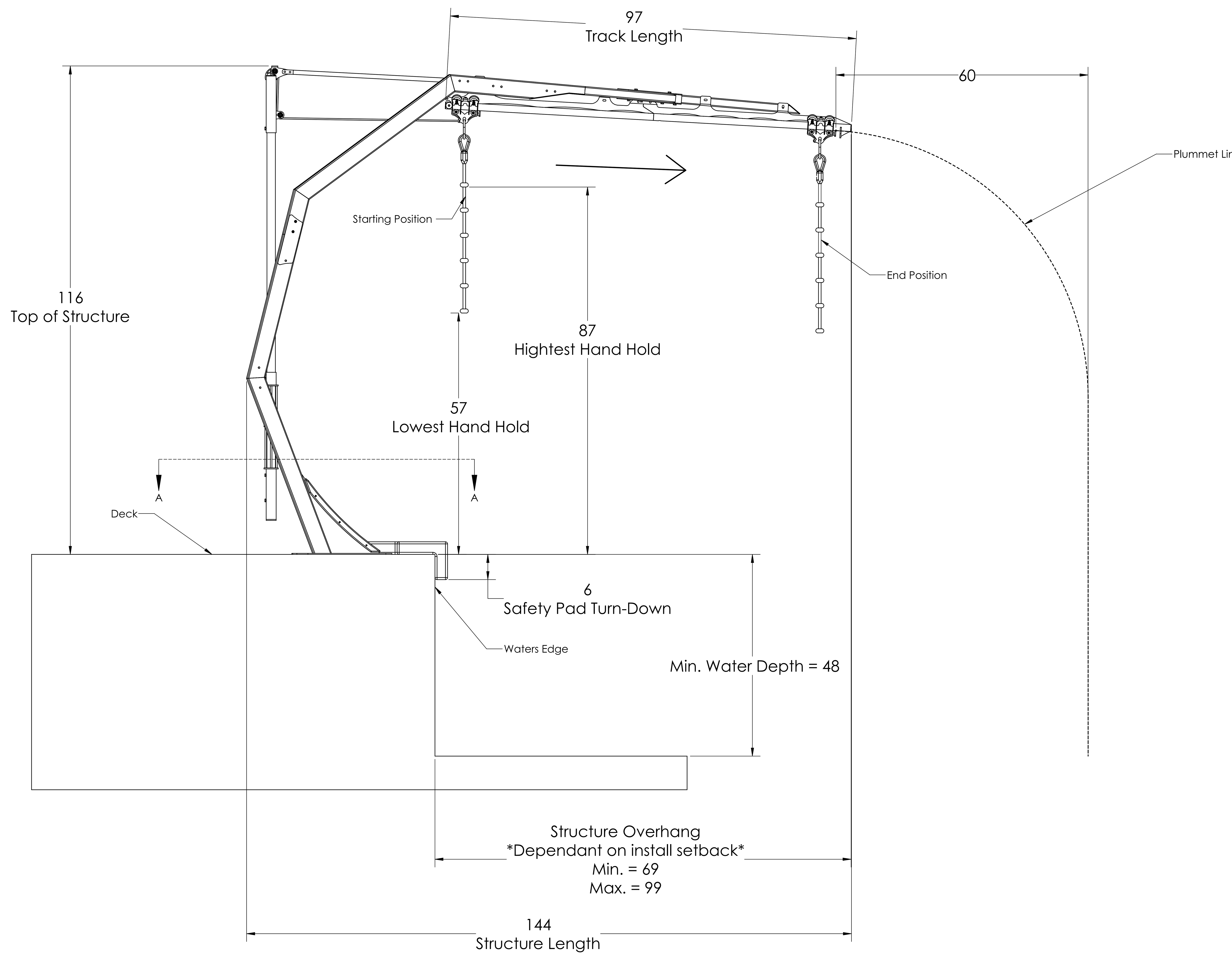

Elevation View/Water Depth Req.

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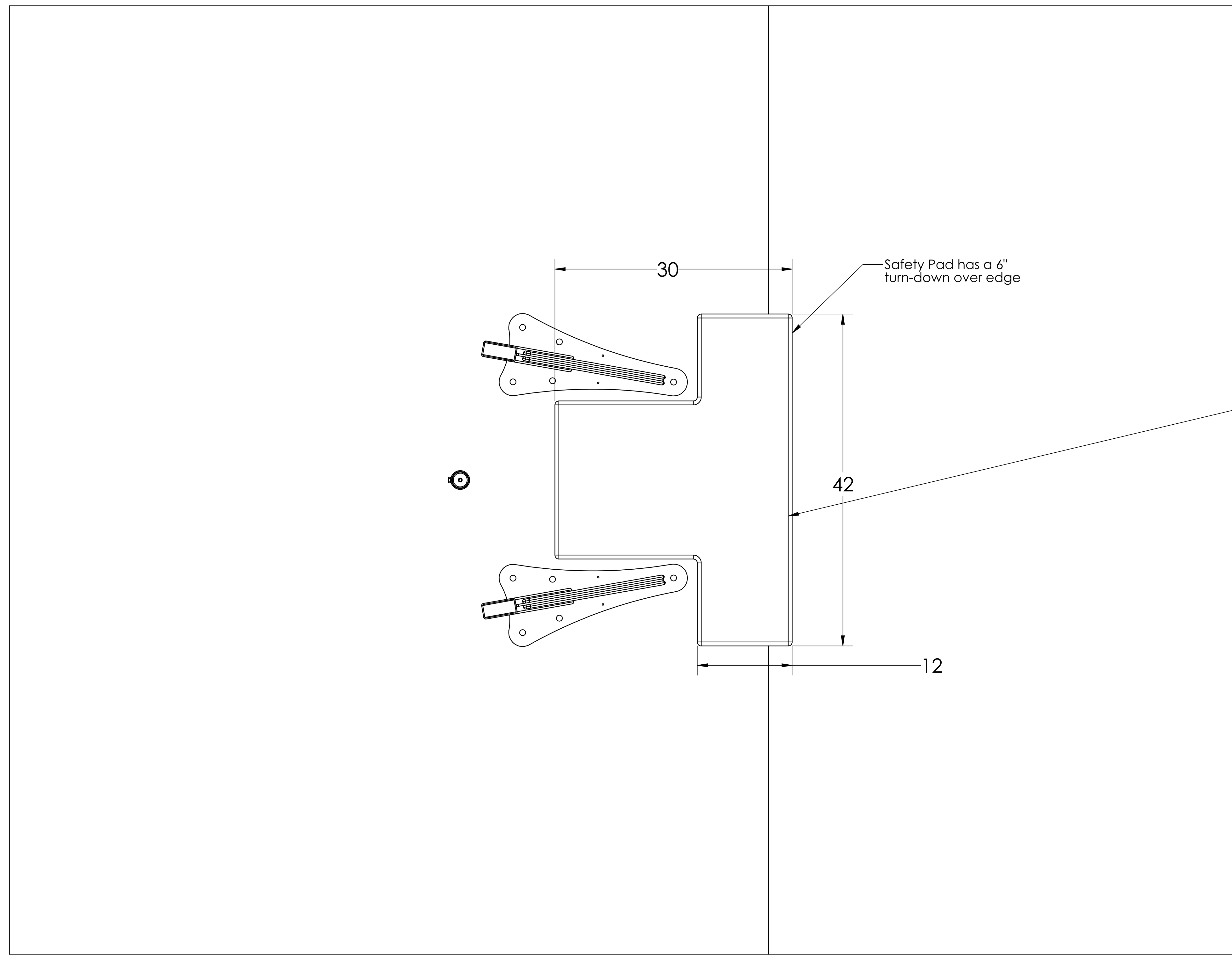

SECTION A-A
SCALE 1 : 10

Safety Pad Dimensions

***Custome safety pads available upon request
to work with any gutter system***

Safety Pad Details

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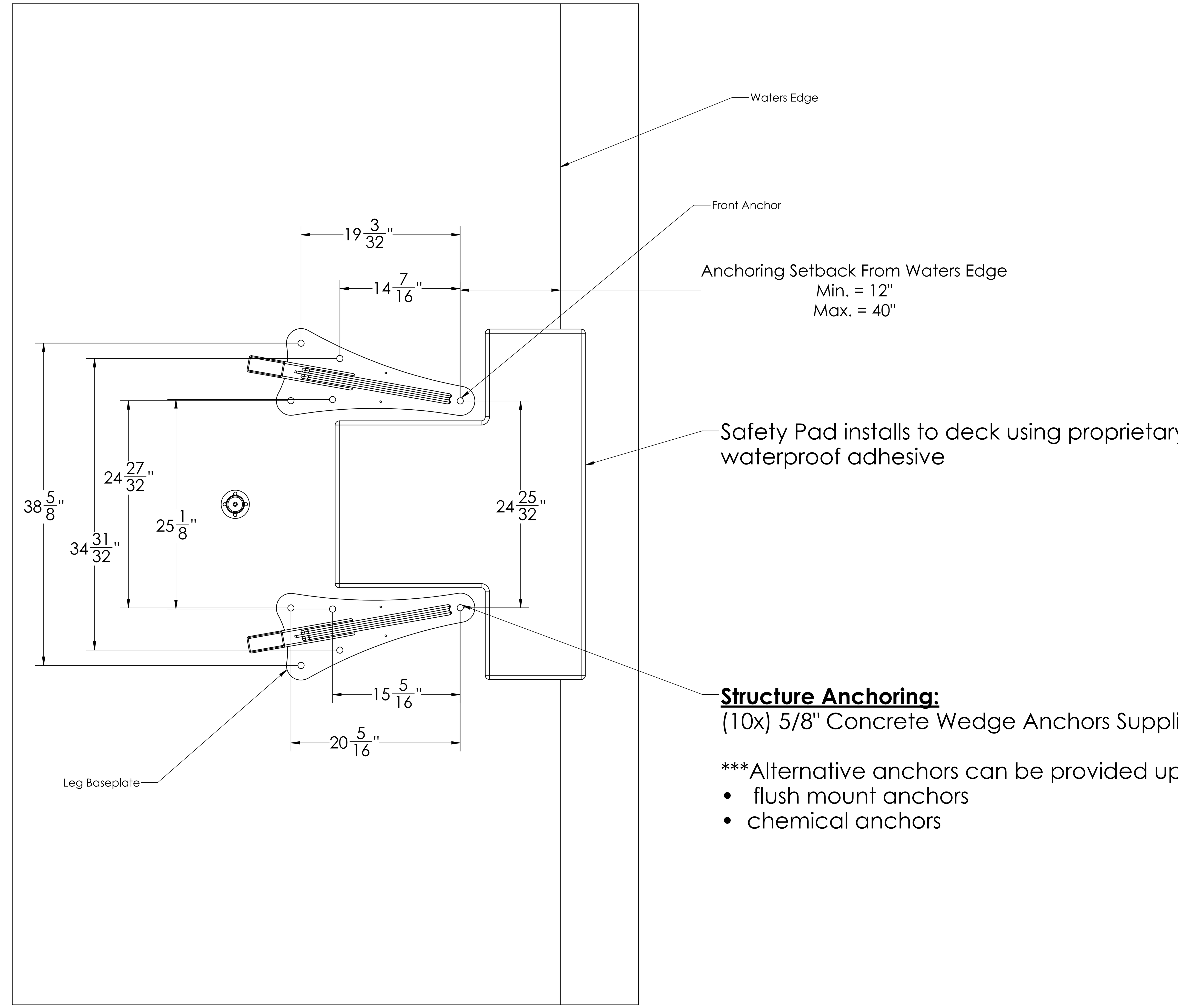

SECTION A-A
SCALE 1 : 8

Structure Anchoring:
(10x) 5/8" Concrete Wedge Anchors Supplied

***Alternative anchors can be provided upon request:
- flush mount anchors
- chemical anchors

Anchor dimensions are for reference only, not to be used for installation. Anchor installation is done by using the Leg Baseplates themselves as drilling templates.

Anchoring Details

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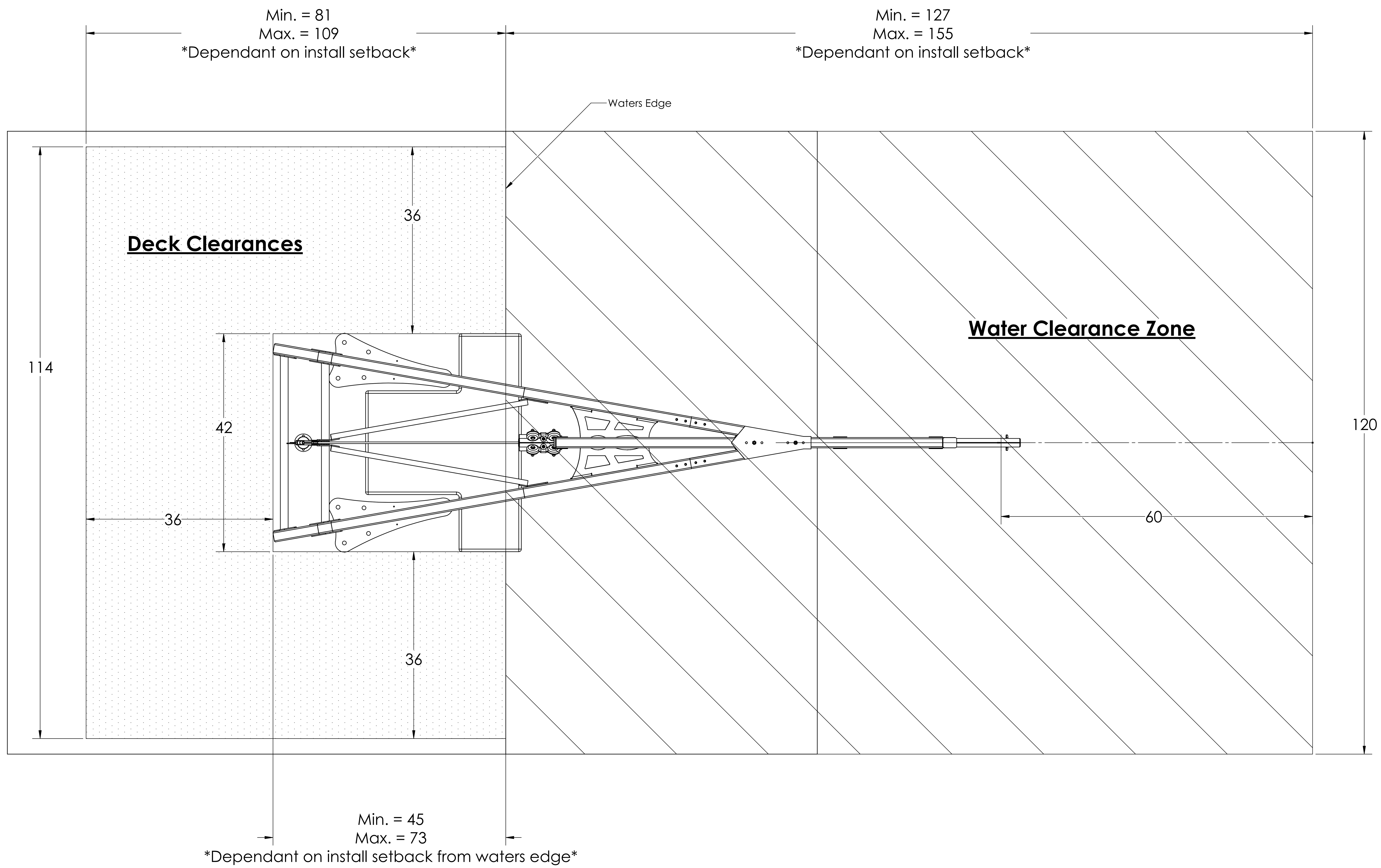
SCALE: 1:1	WEIGHT: 25799.23	SHEET 5 OF 7



Water and Deck Clearances

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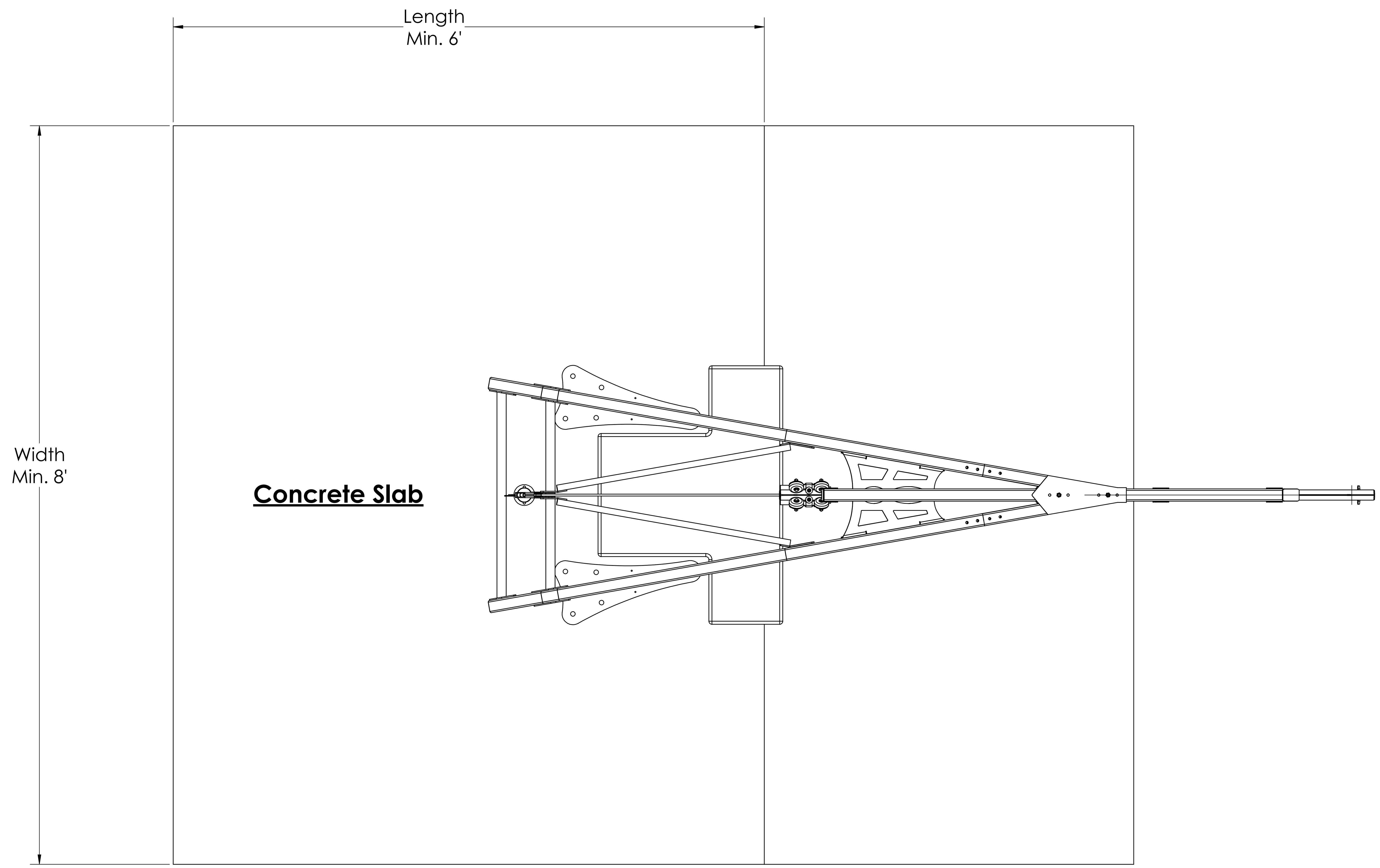

Min. concrete thickness = 4"

Notes:
1. Location of front anchors no closer then 1' to front edge of pad.
2. Concrete dimensions shown are to acheive a min. required square footage. Alternative Lengths and widths can be accepted upon review.
3. Concrete width to be centered on AquaZip'n Frame.
4. Min. concrete thickness of 4" required, with 6x6 W2.0 welded wire mesh ASTM A185.
5. If concrete is new, minimum strength of 3000psi at 28 days is required.

Concrete Slab Requirements

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SCALE: 1:1 | WEIGHT: 25799.23 | SHEET 7 OF 7

ASTM F2291-18 & ASTM F2461-18 STAMPED REVIEW

ZIP'N 3.0 PROTOTYPE

FRAMING AND COMPONENT DESIGN

BASE ANCHORS TYPE REVISED

<u>Prepared For</u>:
Pyramide USA, inc.
8 East 2ND Street
Frederick, MD 21701

WBCM PROJECT NO. 23.0171.00
Date: 06/29/2023
REV: 08/03/2023

COMMONWEALTH OF PENNSYLVANIA
REGISTERED PROFESSIONAL
SHAWN D. WEBER
ENGINEER
PE042688

8.8.23

WBCM
WHITNEY, BAILEY, COX & MAGNANI, LLC
100 Sterling Parkway – Suite 108 Mechanicsburg, PA 17050
MAIN **(717) 691-4708** FAX **(717) 691-4749**

Zip'N 3.0 PROTOTYPE

Design Criteria:

Loading:

- **<u>Live Load:</u>**
  250 lbs MAX Point Load (based on 1 user/rider)
  Deflection Limit L/360

Material:

- Pipes and plates – A304 Stainless Steel, F_y=30 ksi, Fu = 75 ksi
  Pipe – ASTM A312 Standard Spec. for Seamless, welded & Heavy Cold worked Austenitic Stainless Steel Pipe
  Tubing – ASTM A554 Standard Spec for Welded Stainless Steel Mechanical Tubing
- Bolts - ASTM F593 Type 304 Stainless steel bolts

References:

- ASTM F2291-18 Amusement Rides and Devices
- ASTM F2461-18 Aquatic Play Equipment
- Applicable provisions of International Building Code (IBC) 2015 and ASCE 7, Minimum Design Loads for Buildings and Other Structures
- AISC Manual of Steel Construction, 13^{th} Edition, ASD and Steel Design Guide 27 – Structural Stainless Steel

Patty Hayes, Board Chair
Washington State Board of Health
PO Box 47990
Olympia, WA 98504-7990

CHENEY AQUATIC CENTER Variance Letter Date: 2024.07.17

PROJECT IDENTIFICATION: Lap Pool #: SR009200 Leisure Pool #: SR009201

On Behalf of:
Cheney Aquatic Center, City of Cheney
Owner Contact: Dan Curley Phone: 509-498-9293
Owner Address: 609 2nd Street Cheney, WA 99004
Facility Address: 115 North 8th Street (formerly 711 Cedar Street), Cheney, WA 99004

Owner Representative: Brooke Hanley (NAC Architecture) 509-838-8240

Variance Request Contact:
NAC Architecture: Brooke Hanley Phone: 509-838-8240 Email: bhanley@nacarchitecture.com

Facility Information:
Cheney Aquatic Center - Project includes an outdoor 6-lane 25-yard lap pool & separate leisure pool with zero-entry, spray features, & lazy river. The pool building with locker rooms, lifeguard offices, party room, and mechanical spaces is about 5000sf. The entire facility is lifeguarded and enclosed securely.

Plan Submittal: Drawing Plans have been submitted for review.

Variance Request Citation:
WAC 246-262-160 states *the board may grant a variance from requirements of chapter* ***246-262*** *WAC if, in the sole discretion of the board, data and/or research provides sufficient evidence that the RWCF (attraction, device, equipment, procedure, etc.), will adequately protect public health and safety, as well as water quality.*

Variance Request: Code language related to Diving Envelope (WAC 246-262-010(21) & WAC 246-262-060(5)(vi)) for the **NinjaCross Obstacle Course** attraction.

Items noted in review comments include:

- **NinjaCross Obstacle Course** attraction receiving pool shall conform to the CNCA or FINA standards (depth application and setbacks)

In the Spokane Regional Health District review response issued by Steve Main dated May 24, 2024, Steve requests NAC Architecture (NAC) and WaterTechnology, Inc. (WTI) address important concerns regarding public safety related to the receiving pool for the proposed **NinjaCross Obstacle Course** attraction in

Pool B. The concern is to address the minimum depth of the pool to be compliant with the WAC 246-262-010(21) & WAC 246-262-060(5)(c)(vi) regarding diving envelopes for features where users enter the water from above the water surface.

On behalf of the City of Cheney, WA; NAC & WTI respectfully requests your consideration of the current pool depth design at the NinjaCross for the future Cheney Aquatic Center. To support this request we provide the attached information, engineering exhibits, and following commentary:

- The review letter states that the "diving envelope" from WAC 246-262-010(21) applies to **all attractions** where users enter above pool water level and therefore requires the CNCA (enter less than 20" above the water surface) or FINA (enter 20" or greater above the water surface) water depths. We submit that the attached independent engineering calculations for the **NinjaCross Obstacle Course** will demonstrate that the manufacturer's required water depths and the designed water depths provided at the Cheney Aquatic Center are sufficient to protect the safety of the users allowed to participate in this attraction. Calculations were completed for users ranging in height from 51" tall up to 72" tall, and weight ranging from 58lbs to 275lbs. The minimum user height is 48" and the maximum weight is 275lbs. The manufacturer's minimum depth requirement is 3'-6" feet depending on the obstacles purchased for the system. The current Cheney receiving pool water depth ranges from 3'-9" to 4'-0", which exceeds the minimums recommended. Please review the attached engineering calculations in support of using the manufacturer's depth requirements in lieu of the CNCA or FINA diving envelope dimensions. See page 14 for a graphic section depicting an average user height compared and their position in or above the water using each obstacle, in most cases a participant's feet will be submerged or right at the surface of the water. In these calculations, if a person were to drop into 3'-6" deep water from a height of 20" above the surface, the heaviest user would contact the pool floor feet-first with a force equivalent to contacting the ground after a 3.4" high jump on pavement. Quote from review letter, "The participant is expected to contact the pool bottom in a manner that is consistent with any shallow pool activities." The current design of the receiving pool exceeds these calculation assumptions by providing deeper water than the minimum required and will be lifeguarded to prevent people from incorrectly using the obstacles.

- WAC 246-262-060(5)(c)(vi) appears to apply specifically to "diving envelopes in pools or areas of pools <u>designated for diving activities</u>". The applicant submits that diving activities are generally defined as plunging into the water headfirst. Diving headfirst into water results in the need for deeper water to avoid a head & neck collision with the bottom of the pool which is different than a feet-first or tucked entry plunge where the body is significantly slowed in the first 2 feet of water (as noted by the calculations). The **NinjaCross Obstacle Course** safety guidelines (provided in the exhibits) will note that users are required to enter the water in a feet-first manner. Diving from the unit is prohibited. The engineering calculations completed also assumes a feet-first plummet into the water. As users traverse the obstacles, they will generally have their feet dragging in the water and would not drop from a height above the water that is any different from stepping into the pool from the deck edge, see page 14.

- The Model Aquatic Health Code also addresses the complexity of “other aquatic features” like this and would suggest that the manufacturer recommendations for design and operation would be adequate to install the feature.

  4.12.10[A] Other Aquatic Features Other AQUATIC FEATURES not otherwise addressed in the CODE, including but not limited to climbing walls, inflatables, and play structures, shall not be installed unless designed and operated in accordance with all manufacturer’s installation and operations recommendations.

- ‘A-frame’ signs with all written safety guidelines will be publicly displayed near the NinjaCross (see page 100 for example) to meet the criteria of WAC 246-262-070(10).

- Safety padding rated for falls from 6ft or less are provided around the base of the truss structure and down the face of the pool wall to prevent injuries at the corner of the gutter. The entire leisure pool floor is also covered with a ¾” “SoftWalk” material that is available for Myrtha pools which provides a small amount of cushion between the concrete floor and the Myrtha floor membrane and is rated for falls from a height of 1ft per ASTM F1292-04 testing.

- This pool will be lifeguarded at all times while in operation and the lifeguard staff will be the first line of defense to screen bathers to make sure they are experienced swimmers, instruct swimmers on proper use of the attraction, and direct proper swimmer circulation to and from the activity within the pool to avoid congestion or collisions. The **NinjaCross** will have a dedicated lifeguard to closely supervise the safety of swimmers when the attraction is open for use.

- The **NinjaCross** has also been designed and engineered to meet the following standards: Where applicable, NinjaCross follows guidelines from the MAHC (model aquatic health code). As for ASTM, NinjaCross has registered their products as fitness/sporting goods equipment which fall under ASTM F2461-18 Section 1.3.8 Exclusions "1.3.8 Sports equipment, fitness equipment, and diving equipment." This system’s patents and trademarks are registered under Sporting Goods & Fitness equipment and is not classified as an Amusement Ride.

- The City of Cheney is dedicated to making this facility fun while also as safe as possible for their community members and patrons. During community outreach activities, the citizens of Cheney specifically requested a pool design that would have a variety of intriguing activities in varying water depths for users of all comfort levels in the water. Deep water pools come with their own safety risks and lifeguarding challenges. Rescues are much more likely to be needed in deep water where a bather in trouble cannot push off the bottom of the pool to bob back above the surface quickly until the lifeguard can assist them. Shallow water is easier to supervise and guard, so offering additional ways to activate the shallow water areas in a documented safe manner is important for this facility. Many aquatic centers across the country are replacing their lily pad crossing activities (a similar obstacle course feature that only requires 3'-6" to 4'-0" deep water) with the NinjaCross obstacle course because it has been deemed safer than having the lily pad floatables anchored to the floor and permanently obscuring the view of the water below the pads from lifeguard supervision. The NinjaCross obstacles do not have those same supervision issues.

- NinjaCross Systems also provided a list of installed projects across the U.S. and included their receiving pool design depths for reference. Photos of people using the obstacles are also provided for reference. They depict the intention of use where some or most of the swimmer's body will be submerged in the water depending on the height of the obstacle. **See pages 7-8.**

- NAC submits that the design as described above and substantiated in the attached documentation meets the intent of providing a safe receiving pool for the **NinjaCross Obstacle Course** feature. NAC, WTI, and the City of Cheney respectfully requests a variance accordingly. If the State Board of Health has any follow-up conditions or actions required of the owner/operator, we are committed to reviewing them for implementation.

NAC Architecture (NAC) has teamed with Water Technology (WTI) on numerous aquatic projects and so we have a history of producing these projects successfully. WTI has been designing Aquatic venues for over 40 years. WTI is widely known in the industry as one of the leading aquatic design firms in North America. As one of the industry's leaders, WTI has represented the waterpark industry during CPSC meetings on review of VGB rules and has also been involved in reviewing/editing sections of the MAHC. They are also represented in the Washington DOH committee to update the existing administrative code to adopt a more comprehensive aquatic code like the MAHC. The NAC and WTI commitment to safe aquatic facilities is proven. The design of the receiving pool at the **NinjaCross Obstacle Course** for the Cheney Aquatic Center will not put the health and safety of the public at risk. The City of Cheney, having operated a public pool for many years is experienced and committed to the safety and the welfare of their patrons.

On behalf of the City of Cheney, NAC Architecture would like to thank you for your consideration of this Variance Request. Please feel free to contact me with any questions you may have regarding this request.

Thank you,

Brooke Hanley

Brooke Hanley, AIA, Principal Architect, NAC Architecture

Attachments:

- NinjaCross Safety Information and Fall Zone Engineering, including a floor plan and section of the receiving pool for the Cheney Aquatic Center.

REVISIONS

SCHEDULE - CUSTOM RAILGOODS - POOL B

POOL ID	EQUIPMENT ID	EQUIPMENT	QTY	MANUFACTURER	DESCRIPTION
B	01	HAND RAIL	5	PARAGON AQUATICS, SPECTRUM AQUATICS, SR SMITH OR EQUAL	CUSTOM FABRICATED, 316L SS, 1.50" OD x .120 WALL THICKNESS, 500 GRIT FINISH MIN.
B	02	BARRIER RAILING	1	PARAGON AQUATICS, SPECTRUM AQUATICS, SR SMITH OR EQUAL	CUSTOM FABRICATED, 316L SS, 1.50 OD X .120 WALL THICKNESS, 500 GRIT FINISH MIN BARRIER RAILING WITH HTTP KNOTLESS NETTING. PROVIDE 1 3/4" INCH SQUARE MESH. COLOR BY OWNER/ARCHITECT
B	03	BARRIER RAILING	1	PARAGON AQUATICS, SPECTRUM AQUATICS, SR SMITH OR EQUAL	CUSTOM FABRICATED, 316L SS, 1.50 OD X .120 WALL THICKNESS, 500 GRIT FINISH MIN BARRIER RAILING WITH HTTP KNOTLESS NETTING. PROVIDE 1 3/4" INCH SQUARE MESH. COLOR BY OWNER/ARCHITECT

REFER TO MYRTHA DRAWINGS FOR EQUIPMENT INCLUDING BUT NOT LIMITED TO:

HANDRAIL ANCHORS
INWALL STEPS

SCHEDULE - WATER FEATURE - POOL B

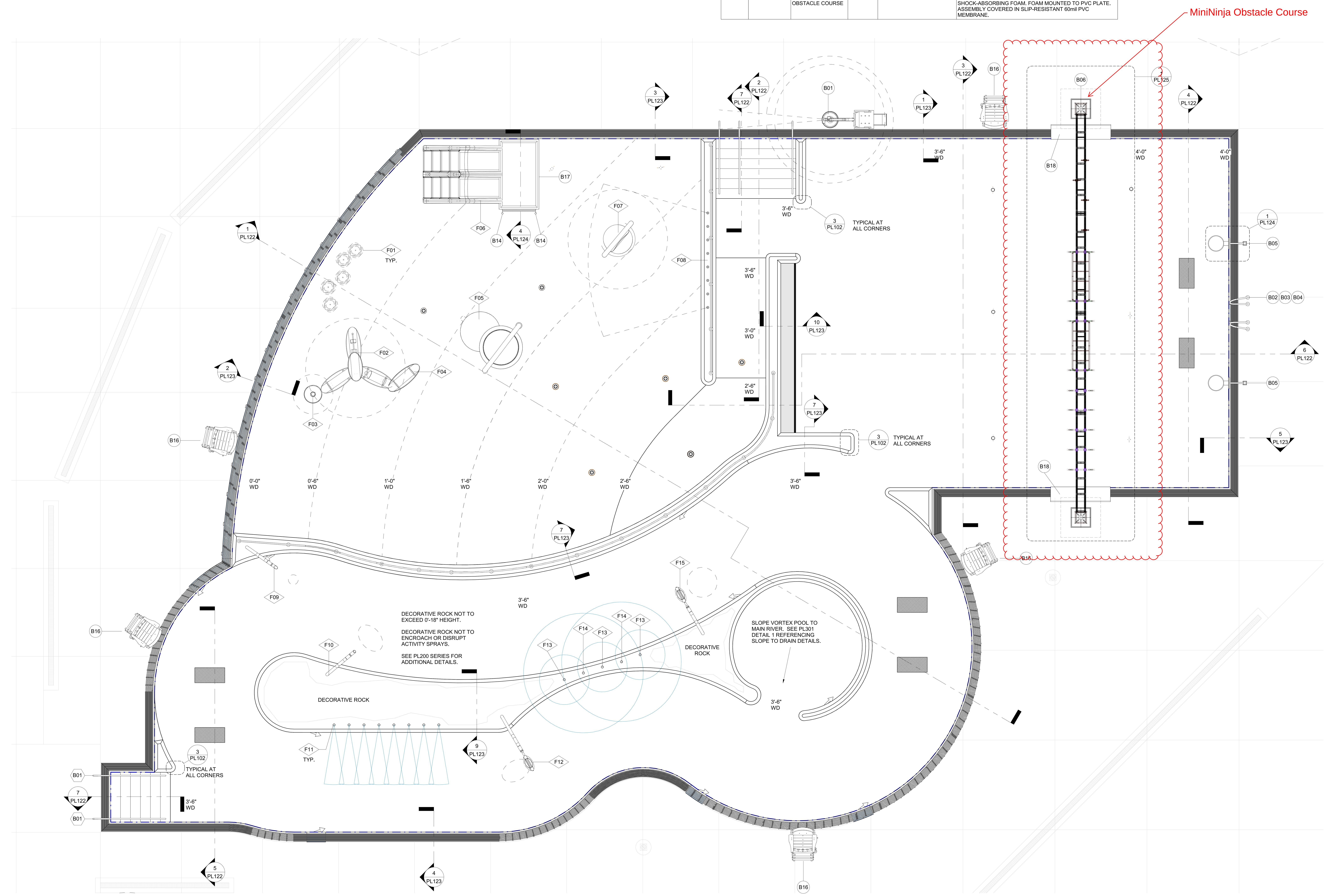
POOL ID	FEATURE ID	FEATURE	QTY	MANUFACTURER	DESCRIPTION	GPM (ea)	GPM (Total)
B	F01	WATER GEYSER	5	CUSTOM	FIELD FABRICATED WATER GEYSER	30	150
B	F02	PLAY FEATURE	1	WATERPLAY	WATERWAYS WATERFALL 3 INTERACTIVE PLAY FEATURE	15	15
B	F03	PLAY FEATURE	1	WATERPLAY	WATERWAYS BASIN INTERACTIVE PLAY FEATURE	5	5
B	F04	AQUATIC PLAY ACTIVITY	1	WATERPLAY	WATERPLAY GULLY PLAY ACTIVITY	7	7
B	F05	SOAKER	1	WATERPLAY	WATERPLAY MEGA SOAKER	40	40
B	F06	SLIDE	1	WATERPLAY	TOT SLIDE	10	10
B	F07	SPRAY FEATURE	1	WATERPLAY	AERIAL SPINSTER	25	25
B	F08	GROUND SPRAY	1	WATERPLAY	SPRAY TUNNEL 8 GROUND SPRAY FEATURE	24	24
B	F09	SPRAY FEATURE	1	WATERPLAY	RIVER SPOUT 1	40	40
B	F10	SPRAY FEATURE	1	WATERPLAY	RIVER NOOK 1	40	40
B	F11	GROUND SPRAY	8	WATERPLAY	TIDAL WAVE GROUND SPRAY	13	104
B	F12	SPRAY FEATURE	1	WATERPLAY	RIVER SPLASH 2	15	15
B	F13	GROUND SPRAY	3	WATERPLAY	CHARLOTTE'S WEB GROUND SPRAY	3	9
B	F14	GROUND SPRAY	2	WATERPLAY	TOWER SPRAY GROUND SPRAY	9	18
B	F15	SPRAY FEATURE	1	WATERPLAY	RIVER SPLASH 1	15	15

SCHEDULE - BASIS OF DESIGN - POOL B

POOL ID	EQUIPMENT ID	EQUIPMENT	QTY	MANUFACTURER	DESCRIPTION
B	01	POOL LIFT	1	SR SMITH, AQUA CREEK, OR EQUAL	STANDARD ANCHORED, ROTATIONAL POOL LIFT, WITH 400 LB MINIMUM LIFTING CAPACITY. MUST MEET ALL APPLICABLE ADA REQUIREMENTS, WHILE MAINTAINING REQUIRED DECK CLEARANCE. PACKAGE TO INCLUDE ARMRESTS, ANCHOR, LIFT COVER, BATTERY CHARGER, AND CADDY
B	02	WEDGE ANCHOR	25	PARAGON AQUATICS, SPECTRUM AQUATICS, SR SMITH OR EQUAL	CAST BRONZE, 4-1/4" LONG, ACCEPTS 1.500" OD TUBING
B	03	ESCUTCHEON PLATE	25	PARAGON AQUATICS, SPECTRUM AQUATICS, SR SMITH OR EQUAL	STAINLESS STEEL ROUND ESCUTCHEON FOR 1.50" O.D. RAILS
B	04	GRAB RAILS (PAIRS)	1	PARAGON AQUATICS, SPECTRUM AQUATICS, SR SMITH OR EQUAL	PRETZEL BEND STYLE, 1.50" OD x .120 WALL THICKNESS, 500 GRIT FINISH MIN.
B	05	BASKETBALL HOOP	2	SR SMITH	STAINLESS STEEL BASKETBALL HOOP WITH ROCKSOLID ANCHOR
B	06	OBSTACLE COURSE	1	NINJACROSS	40' LONG AQUATIC OBSTACLE COURSE ALTERNATE NO. 2
B	14	BARRIER STANCHION	2	PARAGON AQUATICS, SPECTRUM AQUATICS, SR SMITH OR EQUAL	1.900" OD x .145 WALL x 8'-0", PROVIDE SLIDING COLLAR, WITH EYE BOLT
B	16	LIFEGUARD CHAIR	5	TAILWIND, KEIFER, SPECTRUM AQUATICS, SR SMITH OR APPROVED EQUAL	RECYCLED PLASTIC WITH 304 SS HARDWARE, COLOR BY OWNER/ARCHITECT 40" SEAT HEIGHT (OWNER'S SAFETY CONSULTANT TO SPECIFY LOCATION.)
B	17	SAFETY PAD	1	RENOSYS	SAFETY PAD CONTAINING MULTIPLE LAYERS OF DENSE, SHOCK-ABSORBING FOAM. FOAM MOUNTED TO PVC PLATE. ASSEMBLY COVERED IN SLIP-RESISTANT 60mil PVC MEMBRANE.
B	18	SAFETY PAD AT OBSTACLE COURSE	2	RENOSYS	SAFETY PAD CONTAINING MULTIPLE LAYERS OF DENSE, SHOCK-ABSORBING FOAM. FOAM MOUNTED TO PVC PLATE. ASSEMBLY COVERED IN SLIP-RESISTANT 60mil PVC MEMBRANE.

POOL B-LEISURE POOL DATA

DESCRIPTION	QTY	UNITS			
POOL PERIMETER	343	FEET			
WATER SURFACE AREA	5,313	SQUARE FEET			
POOL WATER TEMPERATURE	88	°F			
POOL VOLUME	110,994	GALLONS			
SURGE TANK OPERATING VOLUME	6,637	GALLONS			
TOTAL VOLUME OF WATER	117,631	GALLONS			
CIRCULATION RATE	1,165	GPM			
TURNOVER/VOLUME/FLOW	60 MIN.	22,175	GAL.	370	GPM
TURNOVER/VOLUME/FLOW	120 MIN.	95,457	GAL.	795	GPM
FILTRATION RATE	0.96	GPM/FT^2			
FILTER DRAIN RATE	300	GPM			
SURGE FACTOR	1.07	GAL/SQFT			
AVAILABLE SURGE CAPACITY IN SURGE TANK	5689	GALLONS			



1 PL120 POOL B - LEISURE POOL PLAN VIEW
1/4" = 1'-0"

BID SET

WATER TECHNOLOGY INC.
World Leaders in Aquatic Planning, Design and Engineering
100 Park Avenue | Beaver Dam, WI 53916
t 920.887.7375 | #23458

CITY OF CHENEY
CHENEY AQUATIC CENTER
711 CEDAR ST, CHENEY, WA 99004

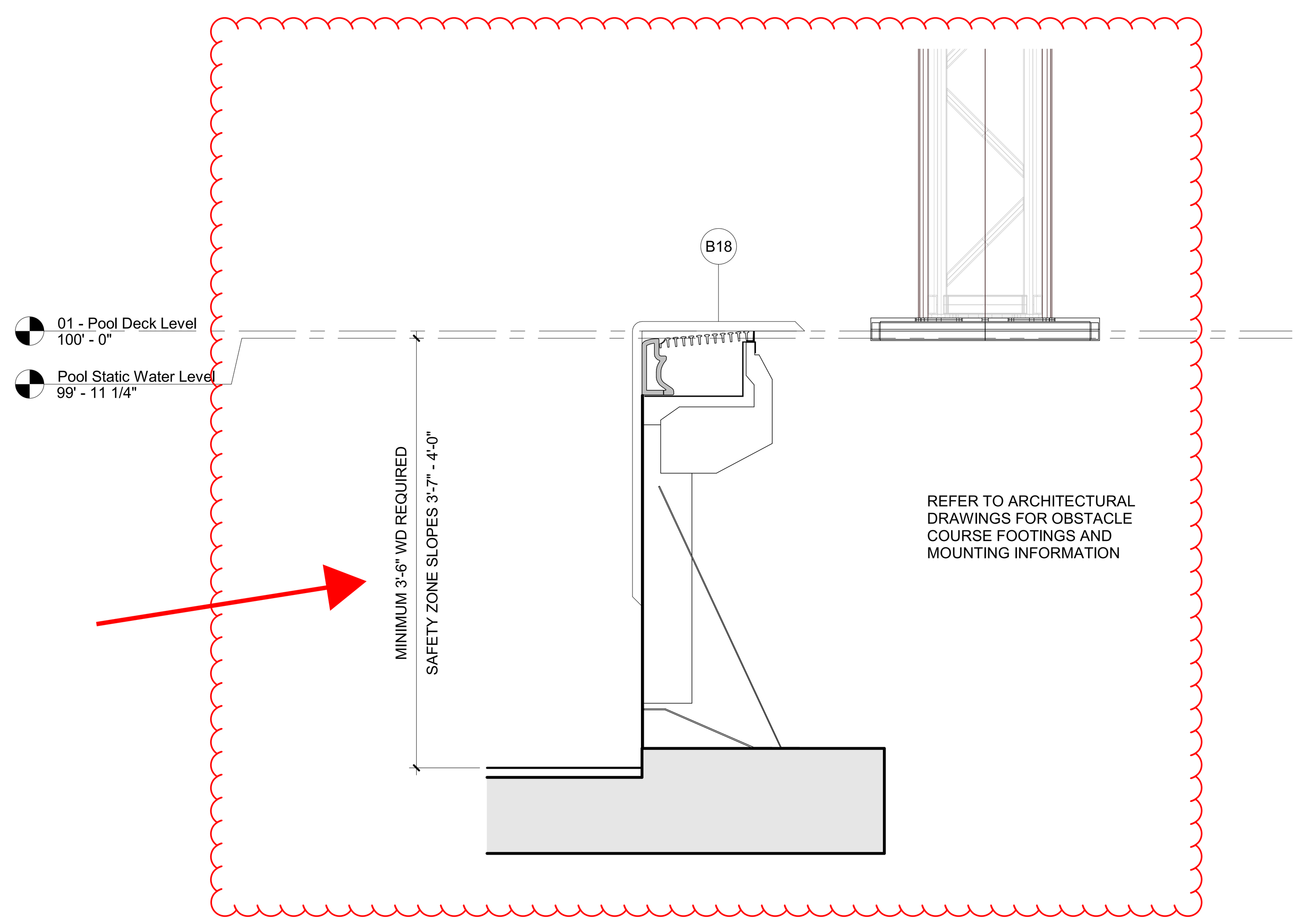
7893 REGISTERED ARCHITECT
MATTHEW W. FREEBY
STATE OF WASHINGTON
4/16/2024

NAC ARCHITECTURE
nacarchitecture.com
1203 WEST RIVERSIDE AVE
SPOKANE WA 99201
P:509.838.8240

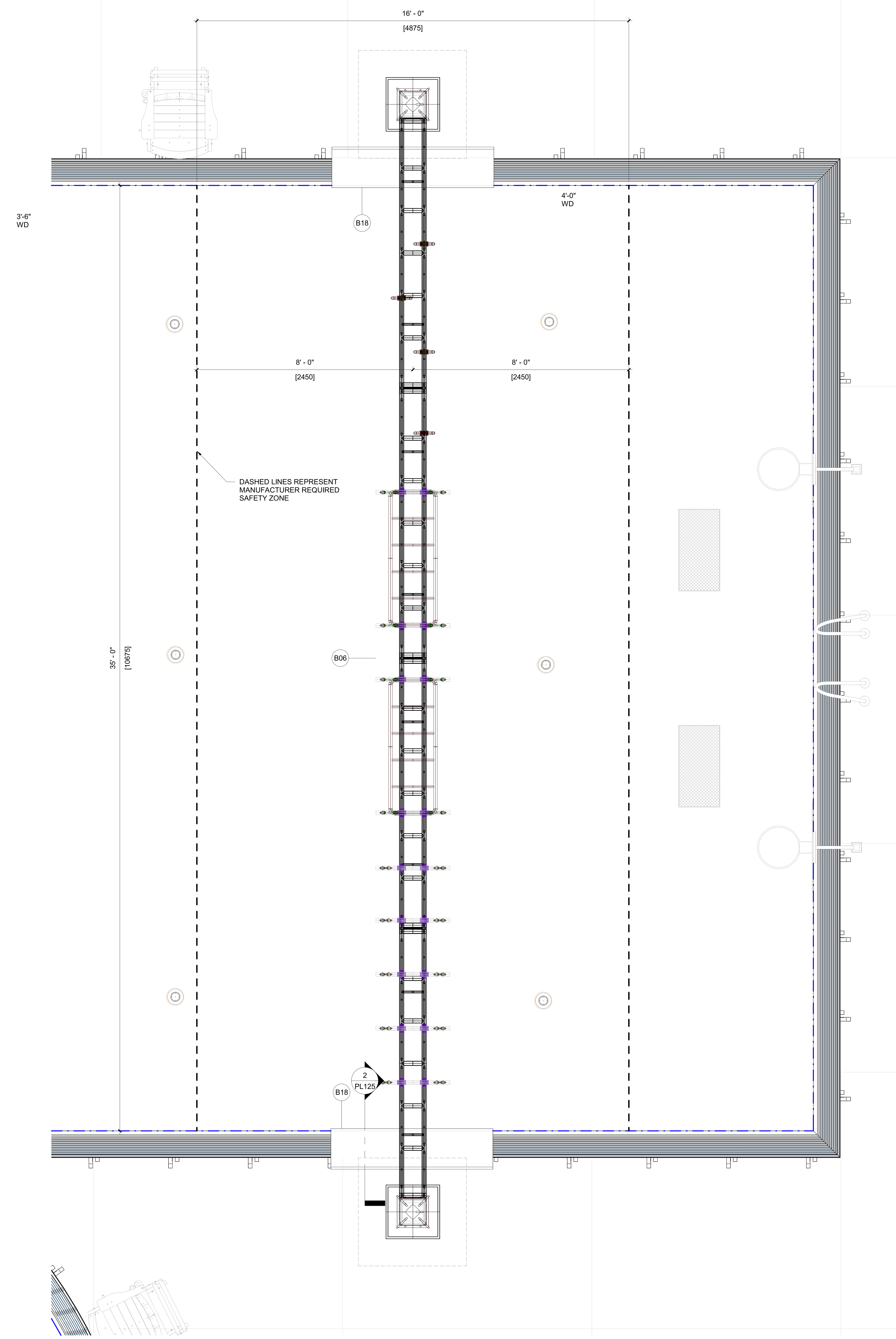
NAC NO	23458
DRAWN	MJC
CHECKED	GGA
DATE	04/16/2024

POOL B - LEISURE POOL PLAN

PL120



2 PL125 WALL AT OBSTACLE COURSE DETAIL VIEW
1" = 1'-0"



1 PL125 POOL B - LEISURE POOL ENLARGED OBSTACLE COURSE PLAN VIEW
1/2" = 1'-0"

REVISIONS

BID SET

WTI
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NAC NO	23458
DRAWN	Author
CHECKED	Checker
DATE	04/16/2024

POOL B - LEISURE POOL OBSTACLE COURSE

PL125

List of similar product installations where the receiving pool depths are similar to Cheney's design

Hi Brooke,

MiniNinja projects are typically in 42" of water around 25'-35' in course length, while our retractable course often is over 25yd/25m pools or 50m pools that start at 42" then slope. In any case, we always design obstacle layouts per the intended water depth & user groups. A similar course has been installed in Europe for 15 years, while we have been building for 5 years around North America.

I'm also attaching some images of younger users that you will primarily find on the MiniNinja course.

Pirates Bay Waterpark, Baytown, TX (42")

Provo Rec Center, UT (42" slopes to 13')

New Ulm Rec Center, MN (48" slopes to 8')

Margaret Carpenter Rec Center, Thornton, CO (48" slopes to 12')

Canfor Leisure Pool, Prince George, BC (42" slopes to 8.5')

Idaho Outdoor Fieldhouse - Challenged Athletes Foundation Headquarters - Boise, ID (42" slopes to 8')

Blue Surf Bay Waterpark, Blue Springs, MO (42" slopes to 12.5')

The Landing Waterpark, Bettendorf, IA (42")

Watertown Family Aquatic Center, SD (42")

Northglenn Rec Center, CO (42" slopes to 54")

Wayman Palmer YMCA, Toledo, OH (42")

Fishers Parks & Rec Center, IN (42")

Margaritaville Hotel & Resort, KS (42")

Jasper Municipal Pool, IN (42")

-Kyle

Kyle Rieger, CPO | Managing Partner
NINJACROSS™ SYSTEMS - Transform Your Pool With the Push of a Button. Game On.
Patent No. US 9,889,387 B2

(O) 800.778.9702 | (M) 913.909.9761
Kyle@NinjaCrossSystems.com
www.NinjaCrossSystems.com


7 FT


5 FT 0 IN

ECLIPSE ENGINEERING

June 12, 2024

Stephen Wagner
Director of Design & Development
NinjaCross™ Systems
stevew@ninjacrosssystems.com

Re: NinjaCross™ Drop Zone Assessment
Spokane Regional Health District
Project #2024-03-129

Stephen,

As requested, Eclipse Engineering has completed the drop zone assessment while using the NinjaCross™ System for the above noted jurisdiction. We utilized data from the CDC to determine the 10th, 50th and 90th percentile for male and female children aged 10, 12, and 14 years old. Using these participants in addition to the maximum user weight for the system, we analyzed a variety of drop orientations into a pool depth of 3'6" from 20" above the surface of the pool, which is comparable to jumping into the water from the pool deck.

While considering the drop orientations from the available system obstacles, we concluded that a drop into the water while using the NinjaCross™ System per its intended use and safety standards would not present a life safety hazard from impacting the water's surface or contacting the pool floor. When a participant who is using the system per design drops from an obstacle, their acceleration stops when they contact the water's surface, and their velocity is significantly reduced within the first 24", thus allowing the participant to contact the pool floor without a sudden impact. The participant is expected to contact the pool bottom in a manner consistent with any shallow pool activities.

Please note that accidents and injuries can happen in any situation regardless of prevention measures put in place. It is the responsibility of the facility, staff, and local governing agencies to follow the operation and maintenance manuals of the NinjaCross™ system to ensure proper use. Eclipse Engineering does not guarantee the health and safety of any participant of a NinjaCross™ system or the facility itself.

Please contact us with any questions.

Sincerely,
Eclipse Engineering, PC

Wade Ambach

Wade Ambach, P.E.
Project Manager
wambach@eclipse-engineering.com

Digitally signed by Rolf Henry Armstrong
DN: E=rarmstrong@eeimt.com, CN=Rolf Henry Armstrong, O="Eclipse Engineering, P.C.", L=Bend, S=Oregon, C=US
Date: 2024.06.14 01:41:26-07'00'

ROLF ARMSTRONG
STATE OF WASHINGTON
39125
STRUCTURAL ENGINEER
PROFESSIONAL ENGINEER

Rolf Armstrong, P.E., S.E.
CFO, Principal Engineer
rarmstrong@eclipse-engineering.com

Attachment: Safe Drop Zone Graphic

ECLIPSE ENGINEERING

STRUCTURAL CALCULATIONS

NinjaCross – Drop Zone Assessment

Digitally signed by Rolf Henry Armstrong
DN: E=rarmstrong@eeimt.com, CN=Rolf Henry Armstrong, O="Eclipse Engineering, P.C.", L=Bend, S=Oregon, C=US
Date: 2024.06.14 01:40:52-07'00'

Prepared For:

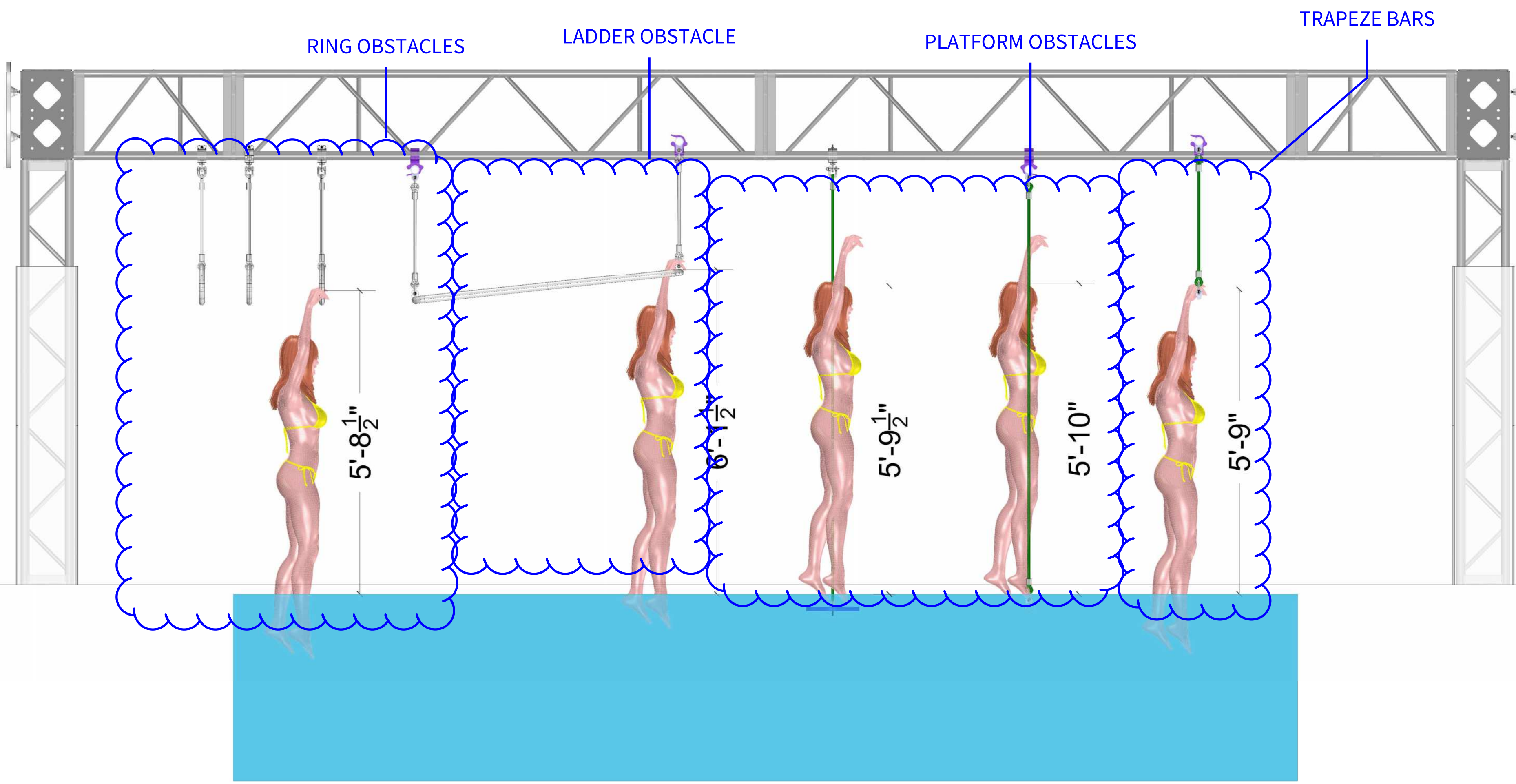
NinjaCross Systems
Kyle W. Rieger, CPO
kyle@ninjacrosssystems.com

TABLE OF CONTENTS

Assumptions

A. DENSITY OF PERSON IS 980 KG/M^3.
B. COEFFICIENT OF DRAG OF PERSON DROPPING THROUGH WATER IS 1.0.
C. PERSON REMAINS STILL THROUGHOUT THE DROP UNTIL MAKING CONTACT WITH THE POOL FLOOR (IF APPLICABLE).
D. THE POOL DEPTH IS 3'-6".
E. PERSON DROPS WITH THEIR FEET 20 INCHES ABOVE THE TOP OF THE WATER.
F. PERSON DROPS FROM REST.

OBSTACLES AND USER CONDITIONS CONSIDERED IN EEPC FALL ZONE REVIEW
MINI NINJA SYSTEM



2 to 20 years: Girls
Stature-for-age and Weight-for-age percentiles

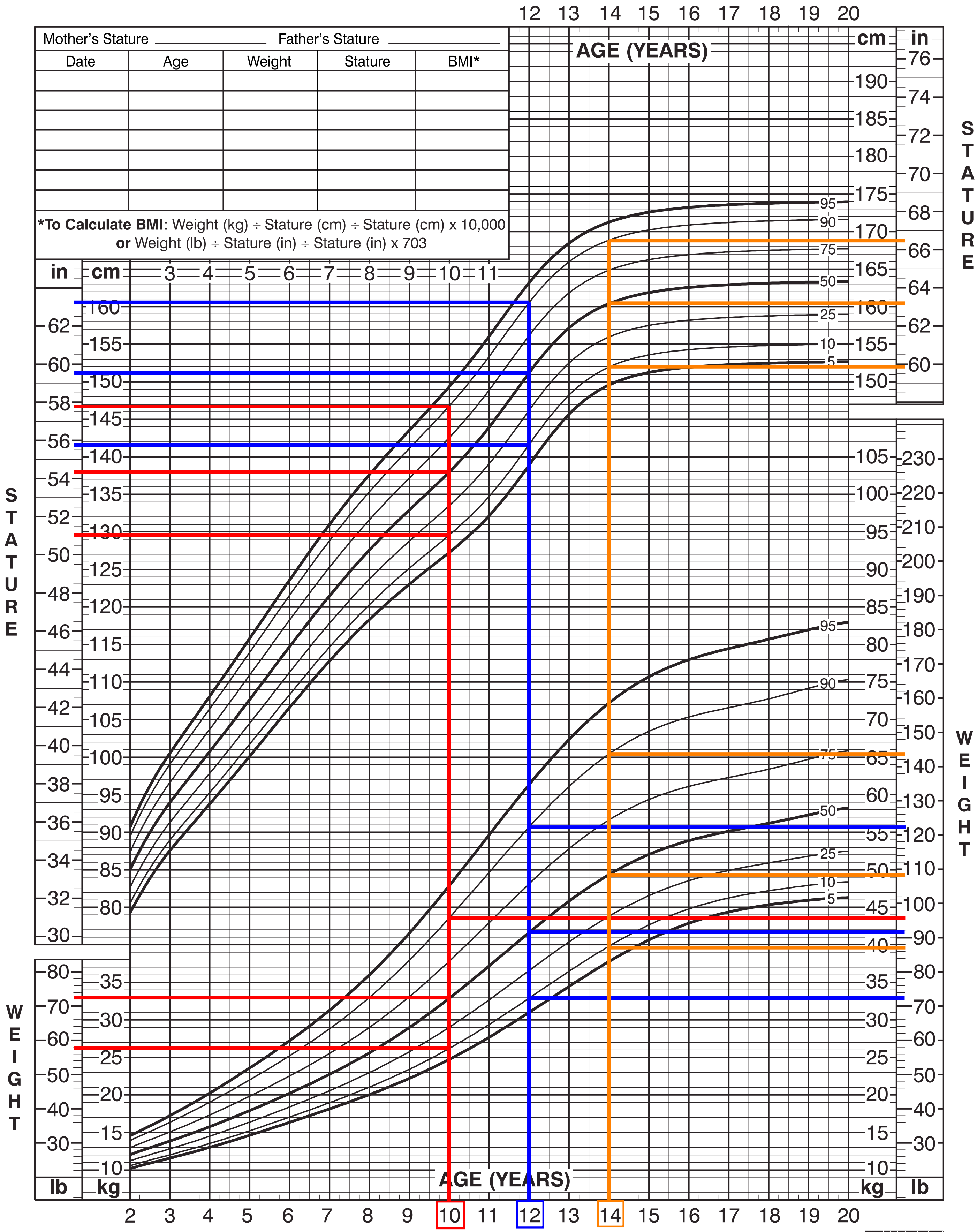
NAME ______________________

RECORD # __________

Mother's Stature ______________ Father's Stature ______________

Date	Age	Weight	Stature	BMI*

***To Calculate BMI**: Weight (kg) ÷ Stature (cm) ÷ Stature (cm) x 10,000
or Weight (lb) ÷ Stature (in) ÷ Stature (in) x 703



Published May 30, 2000 (modified 11/21/00).
SOURCE: Developed by the National Center for Health Statistics in collaboration with the National Center for Chronic Disease Prevention and Health Promotion (2000).
http://www.cdc.gov/growthcharts

SAFER • HEALTHIER • PEOPLE™

2 to 20 years: Boys
Stature-for-age and Weight-for-age percentiles

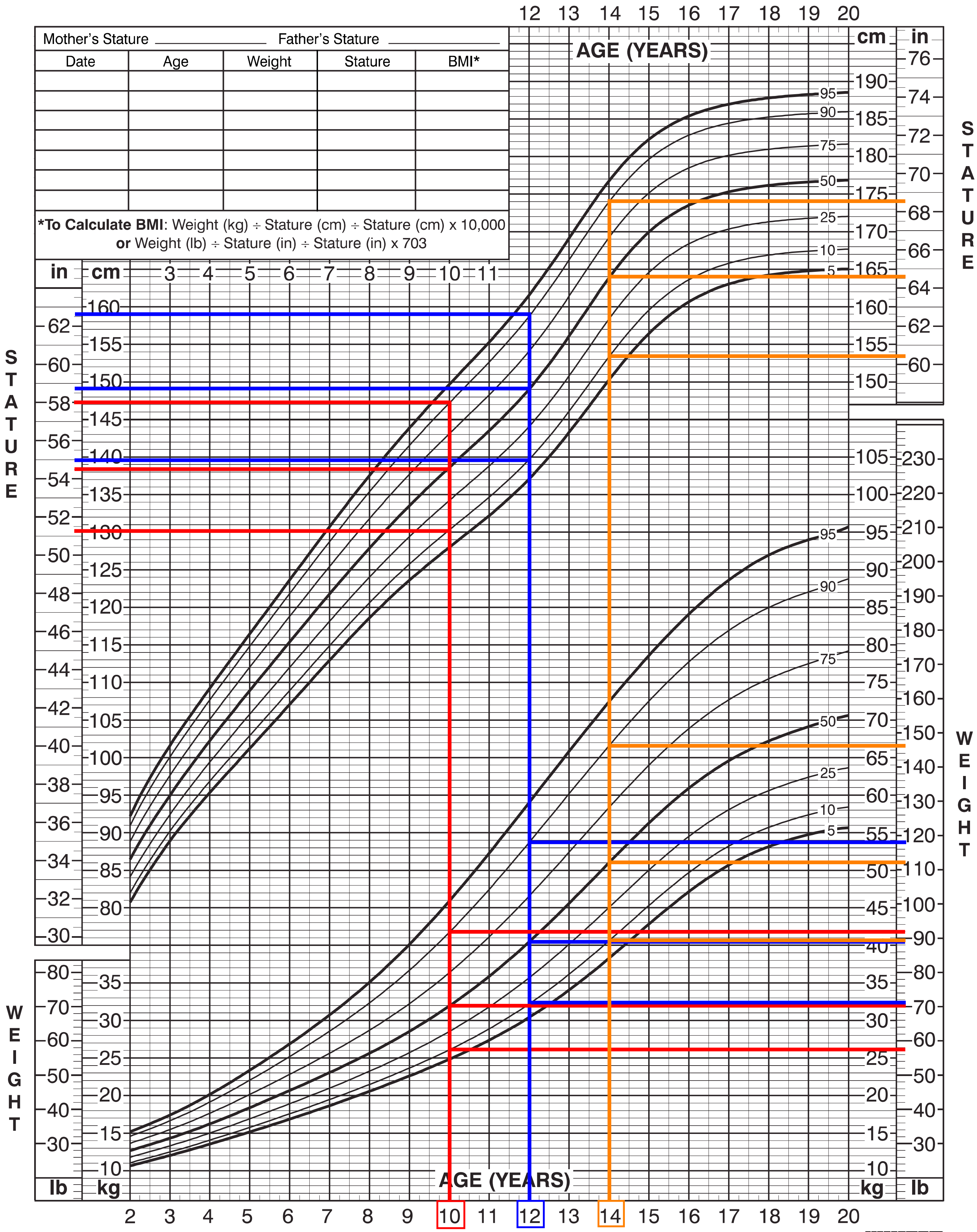
NAME ______________________________

RECORD # __________

Mother's Stature __________ Father's Stature __________

Date	Age	Weight	Stature	BMI*

***To Calculate BMI**: Weight (kg) ÷ Stature (cm) ÷ Stature (cm) x 10,000
or Weight (lb) ÷ Stature (in) ÷ Stature (in) x 703



Published May 30, 2000 (modified 11/21/00).
SOURCE: Developed by the National Center for Health Statistics in collaboration with the National Center for Chronic Disease Prevention and Health Promotion (2000).
http://www.cdc.gov/growthcharts

CDC
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Summary Data

Girls Stature & Weight for Age per CDC			
Age	Percentile	Weight (lb)	Height (in)
10	10	58	51
	50	72	54.5
	90	96	57.75
12	10	72	55.75
	50	92	59.5
	90	122	63.25
14	10	87	59.75
	50	108	63.25
	90	144	66.5

Boys Stature & Weight for Age per CDC			
Age	Percentile	Weight (lb)	Height (in)
10	10	58	51.25
	50	70	54.5
	90	92	58
12	10	71	55
	50	89	58.75
	90	118	62.75
14	10	89	60.5
	50	112	64.5
	90	146	68.5

NinjaCross System Design Participant	
Weight (lb)	Height (in)
275.0	72.0

NinjaCross System Design Participant Results				
	Vertical Drop	Diagonal Drop	Tucked Knee Drop	Horizontal Drop
Velocity at Pool Bottom	2.9 mph	2.9 mph	1.8 mph	0.0 mph
Effective Height of Drop	3.4 in	3.4 in	1.3 in	0.0 in

THE MAXIMUM VELOCITY AT WHICH THE PERSON HITS THE POOL FLOOR IS THAT WITH WHICH A PERSON HITS THE GROUND FROM A 3.4 INCH HEIGHT FALL.

$$mgh = \frac{1}{2}mv^2$$

Effective Height Above Ground $h = \frac{v^2}{2g}$

Please note that OSHA does not consider drops less than 4'-0" to require fall protection

Excerpt from https://www.osha.gov/fall-protection:
"OSHA requires that fall protection be provided at elevations of four feet in general industry workplaces."

Female Participant Results						
Age	Percentile		Vertical Drop	Diagonal Drop	Tucked Knee Drop	Horizontal Drop
10	10	Velocity at Pool Bottom	0.0 mph	0.0 mph	0.0 mph	0.0 mph
		Effective Height of Drop	0.0 in	0.0 in	0.0 in	0.0 in
	50	Velocity at Pool Bottom	0.0 mph	0.0 mph	0.0 mph	0.0 mph
		Effective Height of Drop	0.0 in	0.0 in	0.0 in	0.0 in
	90	Velocity at Pool Bottom	1.3 mph	0.9 mph	0.0 mph	0.0 mph
		Effective Height of Drop	0.7 in	0.3 in	0.0 in	0.0 in
12	10	Velocity at Pool Bottom	0.0 mph	0.0 mph	0.0 mph	0.0 mph
		Effective Height of Drop	0.0 in	0.0 in	0.0 in	0.0 in
	50	Velocity at Pool Bottom	1.3 mph	0.7 mph	0.0 mph	0.0 mph
		Effective Height of Drop	0.7 in	0.2 in	0.0 in	0.0 in
	90	Velocity at Pool Bottom	2.5 mph	2.2 mph	0.0 mph	0.0 mph
		Effective Height of Drop	2.4 in	2.0 in	0.0 in	0.0 in
14	10	Velocity at Pool Bottom	0.9 mph	0.0 mph	0.0 mph	0.0 mph
		Effective Height of Drop	0.3 in	0.0 in	0.0 in	0.0 in
	50	Velocity at Pool Bottom	2.0 mph	1.8 mph	0.0 mph	0.0 mph
		Effective Height of Drop	1.6 in	1.3 in	0.0 in	0.0 in
	90	Velocity at Pool Bottom	2.9 mph	2.9 mph	0.0 mph	0.0 mph
		Effective Height of Drop	3.4 in	3.4 in	0.0 in	0.0 in

Male Participant Results						
Age	Percentile		Vertical Drop	Diagonal Drop	Tucked Knee Drop	Horizontal Drop
10	10	Velocity at Pool Bottom	0.0 mph	0.0 mph	0.0 mph	0.0 mph
		Effective Height of Drop	0.0 in	0.0 in	0.0 in	0.0 in
	50	Velocity at Pool Bottom	0.0 mph	0.0 mph	0.0 mph	0.0 mph
		Effective Height of Drop	0.0 in	0.0 in	0.0 in	0.0 in
	90	Velocity at Pool Bottom	1.1 mph	0.4 mph	0.0 mph	0.0 mph
		Effective Height of Drop	0.5 in	0.1 in	0.0 in	0.0 in
12	10	Velocity at Pool Bottom	0.0 mph	0.0 mph	0.0 mph	0.0 mph
		Effective Height of Drop	0.0 in	0.0 in	0.0 in	0.0 in
	50	Velocity at Pool Bottom	1.1 mph	0.0 mph	0.0 mph	0.0 mph
		Effective Height of Drop	0.5 in	0.0 in	0.0 in	0.0 in
	90	Velocity at Pool Bottom	2.2 mph	2.0 mph	0.0 mph	0.0 mph
		Effective Height of Drop	2.0 in	1.6 in	0.0 in	0.0 in
14	10	Velocity at Pool Bottom	1.1 mph	0.0 mph	0.0 mph	0.0 mph
		Effective Height of Drop	0.5 in	0.0 in	0.0 in	0.0 in
	50	Velocity at Pool Bottom	2.2 mph	1.8 mph	0.0 mph	0.0 mph
		Effective Height of Drop	2.0 in	1.3 in	0.0 in	0.0 in
	90	Velocity at Pool Bottom	3.1 mph	2.9 mph	0.0 mph	0.0 mph
		Effective Height of Drop	3.9 in	3.4 in	0.0 in	0.0 in

NinjaCross System
Design Participant Calculations

Drops Vertically into the Pool

Height of COM	h = 1.42	m	
Mass of Person	m = 124.72	kg =	275 lb
Density of Water	p_w = 1000.00	kg/m^3	
Density of Person	p_B = 980.00	kg/m^3	
Cross-Sectional Area	A = 0.19	m^2 =	2 ft^2
Length of Person	L = 1.83	m =	6 ft
Volume of Person	V = 0.33	m^3	
Coefficient of Drag	C_D = 1.00		
Gravitational Constant	g = 9.81	m/s^2	

Drag Force Equation $$F_D = \frac{1}{2} C_D A p_w v^2$$

Bouyancy Equation $$F_B = Vg(p_w - p_B)$$

Initial Conditions		
t_o =	0	s
v_o =	3.157	mph

ELAPSED TIME (s)	**VELOCITY AT TIME (mph)**	DRAG FORCE (N)	BOUYANCY FORCE (N)	NET FORCE (N)	DISTANCE (m)	**TOTAL DEPTH (ft)**
0	**7.1**				0.0	**0.0**
0.100	5.7	624.2	10.0	-634.2	0.29	0.9
0.200	4.7	432.1	18.2	-450.3	0.52	1.7
0.300	4.1	314.2	25.1	-339.3	0.72	2.4
0.400	3.5	236.3	31.0	-267.3	0.89	2.9
0.500	3.1	182.0	36.2	-218.1	1.04	3.4
0.600	2.7	142.4	40.8	-183.1	1.17	3.8
0.700	2.4	112.6	44.8	-157.4	1.28	4.2
0.800	2.2	89.6	48.4	-138.0	1.39	4.5
0.900	1.9	71.5	51.6	-123.1	1.48	4.9
1.000	1.7	56.9	54.5	-111.4	1.56	5.1
1.100	1.5	45.1	57.1	-102.2	1.63	5.4
1.200	1.4	35.4	59.4	-94.8	1.70	5.6
1.300	1.2	27.5	61.4	-88.9	1.76	5.8
1.400	1.0	20.9	63.2	-84.1	1.81	5.9
1.500	0.9	15.5	64.7	-80.2	1.85	6.1
1.600	0.8	11.1	66.0	-77.1	1.89	6.2
1.700	0.6	7.5	67.1	-74.6	1.92	6.3
1.800	0.5	4.7	68.0	-72.7	1.95	6.4
1.900	0.4	2.6	68.6	-71.2	1.96	6.4
1.980	0.3	1.4	69.0	-70.4	1.98	6.5
2.000	0.2	1.1	69.1	-70.3	1.98	6.5
2.100	0.1	0.3	69.4	-69.7	1.99	6.5

Drops Diagonally into the Pool

Height of COM	h = 1.15	m	
Mass of Person	m = 124.72	kg =	275 lb
Density of Water	p_w = 1000.00	kg/m^3	
Density of Person	p_B = 980.00	kg/m^3	
Cross-Sectional Area	A = 0.19	m^2 =	2 ft^2
Length of Person	L = 1.29	m =	4.24264069 ft
Volume of Person	V = 0.33	m^3	
Coefficient of Drag	C_D = 1.00		
Gravitational Constant	g = 9.81	m/s^2	

Drag Force Equation $$F_D = \frac{1}{2} C_D A p_w v^2$$

Bouyancy Equation $$F_B = Vg(p_w - p_B)$$

Initial Conditions		
t_o =	0	s
v_o =	3.157	mph

ELAPSED TIME (s)	**VELOCITY AT TIME (mph)**	DRAG FORCE (N)	BOUYANCY FORCE (N)	NET FORCE (N)	DISTANCE (m)	**TOTAL DEPTH (ft)**
0	**7.1**				0.0	**0.0**
0.100	5.7	623.6	14.1	-637.7	0.29	0.9
0.200	4.7	430.1	25.7	-455.8	0.52	1.7
0.300	4.0	310.8	35.4	-346.2	0.72	2.3
0.400	3.5	231.6	43.7	-275.3	0.88	2.9
0.500	3.0	176.1	51.0	-227.1	1.03	3.4
0.600	2.7	135.5	57.3	-192.8	1.16	3.8
0.700	2.3	104.9	62.9	-167.8	1.27	4.2
0.800	2.1	81.3	67.7	-149.0	1.37	4.5
0.900	1.8	62.7	72.1	-134.7	1.46	4.8
1.000	1.6	47.8	75.8	-123.6	1.53	5.0
1.100	1.4	35.9	79.1	-115.0	1.60	5.3
1.200	1.2	26.3	81.9	-108.2	1.66	5.4
1.300	1.0	18.6	84.3	-102.9	1.71	5.6
1.400	0.8	12.5	86.3	-98.8	1.75	5.7
1.500	0.6	7.7	87.9	-95.6	1.78	5.8
1.600	0.5	4.2	89.1	-93.3	1.80	5.9
1.700	0.3	1.8	90.0	-91.8	1.82	6.0
1.800	0.1	0.4	90.5	-90.9	1.83	6.0
1.900						
1.980						
2.000						
2.100						

Drops with Tucked Knees into the Pool

Height of COM	h = 0.97	m	
Mass of Person	m = 124.72	kg =	275 lb
Density of Water	p_w = 1000.00	kg/m^3	
Density of Person	p_B = 980.00	kg/m^3	
Cross-Sectional Area	A = 0.28	m^2 =	3 ft^2
Length of Person	L = 0.91	m =	3 ft
Volume of Person	V = 0.33	m^3	
Coefficient of Drag	C_D = 1.00		
Gravitational Constant	g = 9.81	m/s^2	

Drag Force Equation $$F_D = \frac{1}{2} C_D A p_w v^2$$

Bouyancy Equation $$F_B = Vg(p_w - p_B)$$

Initial Conditions		
t_o =	0	s
v_o =	3.157	mph

ELAPSED TIME (s)	**VELOCITY AT TIME (mph)**	DRAG FORCE (N)	BOUYANCY FORCE (N)	NET FORCE (N)	DISTANCE (m)	**TOTAL DEPTH (ft)**
0	**7.1**				0.0	**0.0**
0.100	5.2	783.8	19.1	-802.9	0.27	0.9
0.200	4.0	475.9	33.5	-509.4	0.48	1.6
0.300	3.3	313.5	45.0	-358.5	0.64	2.1
0.400	2.7	216.6	54.5	-271.1	0.78	2.6
0.500	2.3	153.9	62.4	-216.3	0.89	2.9
0.600	2.0	110.7	69.1	-179.9	0.99	3.2
0.700	1.7	79.8	74.8	-154.7	1.07	3.5
0.800	1.4	57.0	79.7	-136.7	1.14	3.7
0.900	1.2	39.9	83.7	-123.6	1.20	3.9
1.000	1.0	26.9	87.1	-114.0	1.25	4.1
1.100	0.8	17.2	89.8	-107.0	1.29	4.2
1.200	0.6	9.9	91.9	-101.9	1.32	4.3
1.300	0.4	4.9	93.5	-98.4	1.34	4.4
1.400	0.2	1.7	94.5	-96.1	1.35	4.4
1.500	0.1	0.1	95.0	-95.1	1.36	4.5
1.600						
1.700						
1.800						
1.900						
1.980						
2.000						
2.100						

Drops Horizontally into the Pool

Height of COM	h = 0.81	m	
Mass of Person	m = 124.72	kg =	275 lb
Density of Water	p_w = 1000.00	kg/m^3	
Density of Person	p_B = 980.00	kg/m^3	
Cross-Sectional Area	A = 0.56	m^2 =	6 ft^2
Length of Person	L = 0.61	m =	2 ft
Volume of Person	V = 0.33	m^3	
Coefficient of Drag	C_D = 1.00		
Gravitational Constant	g = 9.81	m/s^2	

Drag Force Equation $$F_D = \frac{1}{2} C_D A p_w v^2$$

Bouyancy Equation $$F_B = Vg(p_w - p_B)$$

Initial Conditions		
t_o =	0	s
v_o =	3.157	mph

ELAPSED TIME (s)	**VELOCITY AT TIME (mph)**	DRAG FORCE (N)	BOUYANCY FORCE (N)	NET FORCE (N)	DISTANCE (m)	**TOTAL DEPTH (ft)**
0	**7.1**				0.0	**0.0**
0.100	4.0	985.0	25.4	-1010.4	0.24	0.8
0.200	2.8	463.1	41.3	-504.4	0.39	1.3
0.300	2.1	259.2	52.8	-312.0	0.50	1.7
0.400	1.6	157.4	61.6	-219.1	0.59	1.9
0.500	1.3	99.1	68.6	-167.7	0.65	2.1
0.600	1.0	62.6	74.1	-136.7	0.71	2.3
0.700	0.8	38.6	78.5	-117.0	0.75	2.5
0.800	0.6	22.4	81.8	-104.2	0.78	2.6
0.900	0.4	11.5	84.3	-95.8	0.80	2.6
1.000	0.3	4.6	86.0	-90.6	0.82	2.7
1.100	0.1	0.9	87.0	-87.9	0.83	2.7
1.200						
1.300						
1.400						
1.500						
1.600						
1.700						
1.800						
1.900						
1.980						
2.000						
2.100						

10-year-old Girl Calculations

Drops Vertically into the Pool

Height of COM	h = 1.16	m	
Mass of Person	m = 26.30	kg =	58 lb
Density of Water	p_w = 1000.00	kg/m^3	
Density of Person	p_B = 980.00	kg/m^3	
Cross-Sectional Area	A = 0.09	m^2 =	1 ft^2
Length of Person	L = 1.30	m =	4.25 ft
Volume of Person	V = 0.33	m^3	
Coefficient of Drag	C_D = 1.00		
Gravitational Constant	g = 9.81	m/s^2	

Drag Force Equation $$F_D = \frac{1}{2} C_D A p_w v^2$$

Bouyancy Equation $$F_B = Vg(p_w - p_B)$$

Initial Conditions		
t_o =	0	s
v_o =	3.157	mph

ELAPSED TIME (s)	**VELOCITY AT TIME (mph)**	DRAG FORCE (N)	BOUYANCY FORCE (N)	NET FORCE (N)	DISTANCE (m)	**TOTAL DEPTH (ft)**
0	**7.1**				0.0	**0.0**
0.100	4.4	195.3	12.5	-207.8	0.25	0.8
0.200	3.1	96.7	20.8	-117.5	0.42	1.4
0.300	2.3	53.1	26.9	-79.9	0.54	1.8
0.370	1.9	35.5	30.2	-65.6	0.61	2.0
0.400	1.7	29.8	31.4	-61.2	0.64	2.1
0.500	1.3	16.1	34.7	-50.8	0.70	2.3
0.570	1.0	9.8	36.5	-46.3	0.74	2.4
0.600	0.9	7.7	37.1	-44.8	0.75	2.5
0.700	0.5	2.7	38.7	-41.4	0.78	2.6
0.730	0.4	1.8	39.0	-40.8	0.79	2.6
0.800	0.2	0.4	39.5	-39.8	0.80	2.6
0.850		0.0	39.6	-39.6	0.80	2.6

Drops Diagonally into the Pool

Height of COM	h = 0.97	m	
Mass of Person	m = 26.30	kg =	58 lb
Density of Water	p_w = 1000.00	kg/m^3	
Density of Person	p_B = 980.00	kg/m^3	
Cross-Sectional Area	A = 0.09	m^2 =	1 ft^2
Length of Person	L = 0.92	m =	3.00520382 ft
Volume of Person	V = 0.33	m^3	
Coefficient of Drag	C_D = 1.00		
Gravitational Constant	g = 9.81	m/s^2	

Drag Force Equation $F_D = \frac{1}{2} C_D A p_w v^2$

Bouyancy Equation $F_B = Vg(p_w - p_B)$

Initial Conditions		
t_o =	0	s
v_o =	3.157	mph

ELAPSED TIME (s)	**VELOCITY AT TIME (mph)**	DRAG FORCE (N)	BOUYANCY FORCE (N)	NET FORCE (N)	DISTANCE (m)	**TOTAL DEPTH (ft)**
0	**7.1**				0.0	**0.0**
0.100	4.4	193.8	17.7	-211.5	0.25	0.8
0.200	3.1	93.4	29.3	-122.7	0.42	1.4
0.300	2.2	48.6	37.6	-86.2	0.54	1.8
0.370	1.8	30.5	42.0	-72.5	0.60	2.0
0.400	1.6	24.7	43.6	-68.3	0.62	2.0
0.500	1.0	11.1	47.7	-58.8	0.68	2.2
0.570	0.7	5.2	49.7	-54.9	0.71	2.3
0.600	0.6	3.5	50.3	-53.8	0.72	2.4
0.700	0.1	0.3	51.4	-51.7	0.74	2.4
0.730		0.0	51.5	-51.5	0.74	2.4
0.800						
0.850						

Drops with Tucked Knees into the Pool

Height of COM	h = 0.83	m	
Mass of Person	m = 26.30	kg =	58 lb
Density of Water	p_w = 1000.00	kg/m^3	
Density of Person	p_B = 980.00	kg/m^3	
Cross-Sectional Area	A = 0.20	m^2 =	2.125 ft^2
Length of Person	L = 0.65	m =	2.125 ft
Volume of Person	V = 0.33	m^3	
Coefficient of Drag	C_D = 1.00		
Gravitational Constant	g = 9.81	m/s^2	

Drag Force Equation $$F_D = \frac{1}{2} C_D A p_w v^2$$

Bouyancy Equation $$F_B = V g (p_w - p_B)$$

Initial Conditions		
t_o =	0	s
v_o =	3.157	mph

ELAPSED TIME (s)	**VELOCITY AT TIME (mph)**	DRAG FORCE (N)	BOUYANCY FORCE (N)	NET FORCE (N)	DISTANCE (m)	**TOTAL DEPTH (ft)**
0	**7.1**				0.0	**0.0**
0.100	3.0	202.3	20.7	-223.0	0.21	0.7
0.200	1.8	70.4	31.2	-101.6	0.32	1.0
0.300	1.1	27.8	37.8	-65.6	0.38	1.3
0.370	0.8	13.6	40.8	-54.3	0.41	1.4
0.400	0.6	9.5	41.7	-51.2	0.42	1.4
0.500	0.2	1.6	43.8	-45.4	0.44	1.5
0.570		0.0	44.2	-44.2	0.45	1.5
0.600						
0.700						
0.730						
0.800						
0.850						

Drops Horizontally into the Pool

Height of COM	h = 0.66	m	
Mass of Person	m = 26.30	kg =	58 lb
Density of Water	p_w = 1000.00	kg/m^3	
Density of Person	p_B = 980.00	kg/m^3	
Cross-Sectional Area	A = 0.39	m^2 =	4.25 ft^2
Length of Person	L = 0.30	m =	1 ft
Volume of Person	V = 0.33	m^3	
Coefficient of Drag	C_D = 1.00		
Gravitational Constant	g = 9.81	m/s^2	

Drag Force Equation $$F_D = \frac{1}{2} C_D A p_w v^2$$

Bouyancy Equation $$F_B = Vg(p_w - p_B)$$

Initial Conditions		
t_o =	0	s
v_o =	3.157	mph

ELAPSED TIME (s)	**VELOCITY AT TIME (mph)**	DRAG FORCE (N)	BOUYANCY FORCE (N)	NET FORCE (N)	DISTANCE (m)	**TOTAL DEPTH (ft)**
0	**7.1**				0.0	**0.0**
0.100	1.8	149.5	33.5	-182.9	0.16	0.5
0.200	0.8	32.9	45.7	-78.6	0.22	0.7
0.300	0.3	4.9	51.2	-56.1	0.24	0.8
0.370		0.0	52.3	-52.3	0.25	0.8
0.400						
0.500						
0.570						
0.600						
0.700						
0.730						
0.800						
0.850						

Drops Vertically into the Pool

Height of COM	h = 1.20	m	
Mass of Person	m = 32.65	kg =	72 lb
Density of Water	p_w = 1000.00	kg/m^3	
Density of Person	p_B = 980.00	kg/m^3	
Cross-Sectional Area	A = 0.09	m^2 =	1 ft^2
Length of Person	L = 1.38	m =	4.54166667 ft
Volume of Person	V = 0.33	m^3	
Coefficient of Drag	C_D = 1.00		
Gravitational Constant	g = 9.81	m/s^2	

Drag Force Equation $$F_D = \frac{1}{2} C_D A p_w v^2$$

Bouyancy Equation $$F_B = Vg(p_w - p_B)$$

Initial Conditions		
t_o =	0	s
v_o =	3.157	mph

ELAPSED TIME (s)	**VELOCITY AT TIME (mph)**	DRAG FORCE (N)	BOUYANCY FORCE (N)	NET FORCE (N)	DISTANCE (m)	**TOTAL DEPTH (ft)**
0	**7.1**				0.0	**0.0**
0.100	4.8	226.4	12.2	-238.6	0.26	0.9
0.200	3.5	123.2	20.8	-143.9	0.45	1.5
0.300	2.7	73.1	27.3	-100.4	0.59	1.9
0.400	2.1	44.9	32.4	-77.2	0.70	2.3
0.500	1.7	27.3	36.3	-63.6	0.79	2.6
0.600	1.3	15.9	39.4	-55.3	0.85	2.8
0.660	1.1	11.0	40.8	-51.8	0.89	2.9
0.700	0.9	8.3	41.7	-50.0	0.90	3.0
0.800	0.6	3.5	43.2	-46.8	0.94	3.1
0.850	0.4	1.9	43.8	-45.7	0.95	3.1
0.900	0.3	0.8	44.2	-45.0	0.96	3.1
0.990		0.0	44.4	-44.4	0.96	3.2

Drops Diagonally into the Pool

Height of COM	h = 1.00	m	
Mass of Person	m = 32.65	kg =	72 lb
Density of Water	p_w = 1000.00	kg/m^3	
Density of Person	p_B = 980.00	kg/m^3	
Cross-Sectional Area	A = 0.09	m^2 =	1 ft^2
Length of Person	L = 0.98	m =	3.2114433 ft
Volume of Person	V = 0.33	m^3	
Coefficient of Drag	C_D = 1.00		
Gravitational Constant	g = 9.81	m/s^2	

Drag Force Equation $$F_D = \frac{1}{2} C_D A p_w v^2$$

Bouyancy Equation $$F_B = Vg(p_w - p_B)$$

Initial Conditions		
t_o =	0	s
v_o =	3.157	mph

ELAPSED TIME (s)	**VELOCITY AT TIME (mph)**	DRAG FORCE (N)	BOUYANCY FORCE (N)	NET FORCE (N)	DISTANCE (m)	**TOTAL DEPTH (ft)**
0	**7.1**				0.0	**0.0**
0.100	4.8	225.2	17.2	-242.4	0.26	0.9
0.200	3.5	120.1	29.3	-149.4	0.45	1.5
0.300	2.6	68.7	38.3	-107.0	0.59	1.9
0.400	2.0	39.5	45.1	-84.7	0.69	2.3
0.500	1.5	21.6	50.3	-71.9	0.77	2.5
0.600	1.0	10.4	54.0	-64.4	0.83	2.7
0.660	0.8	5.9	55.6	-61.5	0.85	2.8
0.700	0.6	3.7	56.4	-60.1	0.86	2.8
0.800	0.2	0.5	57.6	-58.0	0.88	2.9
0.850		0.0	57.7	-57.7	0.88	2.9
0.900						
0.990						

Drops with Tucked Knees into the Pool

Height of COM	h = 0.85	m	
Mass of Person	m = 32.65	kg =	72 lb
Density of Water	p_w = 1000.00	kg/m^3	
Density of Person	p_B = 980.00	kg/m^3	
Cross-Sectional Area	A = 0.21	m^2 =	2.270833 ft^2
Length of Person	L = 0.69	m =	2.27083333 ft
Volume of Person	V = 0.33	m^3	
Coefficient of Drag	C_D = 1.00		
Gravitational Constant	g = 9.81	m/s^2	

Drag Force Equation $F_D = \frac{1}{2} C_D A p_w v^2$

Bouyancy Equation $F_B = V g (p_w - p_B)$

Initial Conditions		
t_o =	0	s
v_o =	3.157	mph

ELAPSED TIME (s)	**VELOCITY AT TIME (mph)**	DRAG FORCE (N)	BOUYANCY FORCE (N)	NET FORCE (N)	DISTANCE (m)	**TOTAL DEPTH (ft)**
0	**7.1**				0.0	**0.0**
0.100	3.3	257.6	20.3	-277.8	0.22	0.7
0.200	2.1	98.2	31.3	-129.5	0.34	1.1
0.300	1.4	43.8	38.5	-82.3	0.42	1.4
0.400	0.9	19.0	43.3	-62.2	0.47	1.5
0.500	0.5	6.5	46.3	-52.8	0.50	1.6
0.600	0.2	0.9	47.8	-48.7	0.52	1.7
0.660		0.0	48.0	-48.0	0.52	1.7
0.700						
0.800						
0.850						
0.900						
0.990						

Drops Horizontally into the Pool

Height of COM	$h = 0.66$	m	
Mass of Person	$m = 32.65$	kg =	72 lb
Density of Water	$p_w = 1000.00$	kg/m^3	
Density of Person	$p_B = 980.00$	kg/m^3	
Cross-Sectional Area	$A = 0.42$	m^2 =	4.541667 ft^2
Length of Person	$L = 0.30$	m =	1 ft
Volume of Person	$V = 0.33$	m^3	
Coefficient of Drag	$C_D = 1.00$		
Gravitational Constant	$g = 9.81$	m/s^2	

Drag Force Equation $$F_D = \frac{1}{2} C_D A p_w v^2$$

Bouyancy Equation $$F_B = Vg(p_w - p_B)$$

Initial Conditions		
t_o =	0	s
v_o =	3.157	mph

ELAPSED TIME (s)	**VELOCITY AT TIME (mph)**	DRAG FORCE (N)	BOUYANCY FORCE (N)	NET FORCE (N)	DISTANCE (m)	**TOTAL DEPTH (ft)**
0	**7.1**				0.0	**0.0**
0.100	2.0	204.9	35.8	-240.7	0.17	0.6
0.200	1.0	52.0	50.1	-102.1	0.24	0.8
0.300	0.5	12.0	57.4	-69.4	0.27	0.9
0.400	0.1	0.4	60.0	-60.4	0.29	0.9
0.500						
0.600						
0.660						
0.700						
0.800						
0.850						
0.900						
0.990						

Drops Vertically into the Pool

Height of COM	h = 1.24	m	
Mass of Person	m = 43.54	kg =	96 lb
Density of Water	p_w = 1000.00	kg/m^3	
Density of Person	p_B = 980.00	kg/m^3	
Cross-Sectional Area	A = 0.09	m^2 =	1 ft^2
Length of Person	L = 1.47	m =	4.8125 ft
Volume of Person	V = 0.33	m^3	
Coefficient of Drag	C_D = 1.00		
Gravitational Constant	g = 9.81	m/s^2	

Drag Force Equation $F_D = \frac{1}{2} C_D A p_w v^2$

Bouyancy Equation $F_B = Vg(p_w - p_B)$

Initial Conditions		
t_o =	0	s
v_o =	3.157	mph

ELAPSED TIME (s)	**VELOCITY AT TIME (mph)**	DRAG FORCE (N)	BOUYANCY FORCE (N)	NET FORCE (N)	DISTANCE (m)	**TOTAL DEPTH (ft)**
0	**7.1**				0.0	**0.0**
0.100	5.2	266.3	12.0	-278.2	0.27	0.9
0.200	4.1	161.8	21.0	-182.9	0.48	1.6
0.300	3.3	105.0	28.3	-133.2	0.65	2.1
0.400	2.7	70.3	34.1	-104.4	0.78	2.6
0.490	2.3	49.3	38.5	-87.8	0.88	2.9
0.500	2.2	47.4	38.9	-86.3	0.89	2.9
0.600	1.8	31.6	42.9	-74.5	0.98	3.2
0.700	1.4	20.4	46.1	-66.5	1.06	3.5
0.790	1.2	13.1	48.4	-61.5	1.11	3.6
0.800	1.1	12.4	48.6	-61.0	1.12	3.7
0.900	0.8	6.7	50.5	-57.3	1.16	3.8
1.000	0.5	2.9	51.9	-54.8	1.19	3.9
1.100	0.3	0.7	52.7	-53.4	1.21	4.0
1.200		0.0	52.9	-52.9	1.22	4.0

Drops Diagonally into the Pool

Height of COM	h = 1.03	m	
Mass of Person	m = 43.54	kg =	96 lb
Density of Water	p_w = 1000.00	kg/m^3	
Density of Person	p_B = 980.00	kg/m^3	
Cross-Sectional Area	A = 0.09	m^2 =	1 ft^2
Length of Person	L = 1.04	m =	3.40295138 ft
Volume of Person	V = 0.33	m^3	
Coefficient of Drag	C_D = 1.00		
Gravitational Constant	g = 9.81	m/s^2	

Drag Force Equation $F_D = \frac{1}{2} C_D A p_w v^2$

Bouyancy Equation $F_B = Vg(p_w - p_B)$

Initial Conditions		
t_o =	0	s
v_o =	3.157	mph

ELAPSED TIME (s)	**VELOCITY AT TIME (mph)**	DRAG FORCE (N)	BOUYANCY FORCE (N)	NET FORCE (N)	DISTANCE (m)	**TOTAL DEPTH (ft)**
0	**7.1**				0.0	**0.0**
0.100	5.2	265.2	16.9	-282.1	0.27	0.9
0.200	4.0	159.1	29.7	-188.8	0.48	1.6
0.300	3.2	100.7	39.7	-140.5	0.65	2.1
0.400	2.6	64.8	47.8	-112.6	0.78	2.5
0.490	2.1	43.2	53.7	-96.8	0.87	2.9
0.500	2.1	41.2	54.2	-95.4	0.88	2.9
0.600	1.6	25.1	59.3	-84.4	0.96	3.2
0.700	1.2	14.0	63.2	-77.2	1.03	3.4
0.790	0.8	7.2	65.8	-73.0	1.07	3.5
0.800	0.8	6.6	66.0	-72.6	1.07	3.5
0.900	0.4	2.1	67.8	-69.9	1.10	3.6
1.000	0.1	0.1	68.5	-68.7	1.11	3.7
1.100						
1.200						

Drops with Tucked Knees into the Pool

Height of COM	h = 0.87	m	
Mass of Person	m = 43.54	kg =	96 lb
Density of Water	p_w = 1000.00	kg/m^3	
Density of Person	p_B = 980.00	kg/m^3	
Cross-Sectional Area	A = 0.22	m^2 =	2.40625 ft^2
Length of Person	L = 0.73	m =	2.40625 ft
Volume of Person	V = 0.33	m^3	
Coefficient of Drag	C_D = 1.00		
Gravitational Constant	g = 9.81	m/s^2	

Drag Force Equation $$F_D = \frac{1}{2} C_D A p_w v^2$$

Bouyancy Equation $$F_B = Vg(p_w - p_B)$$

Initial Conditions		
t_o =	0	s
v_o =	3.157	mph

ELAPSED TIME (s)	**VELOCITY AT TIME (mph)**	DRAG FORCE (N)	BOUYANCY FORCE (N)	NET FORCE (N)	DISTANCE (m)	**TOTAL DEPTH (ft)**
0	**7.1**				0.0	**0.0**
0.100	3.7	345.5	20.4	-365.9	0.23	0.8
0.200	2.5	148.0	32.5	-180.5	0.37	1.2
0.300	1.8	74.2	40.8	-115.0	0.47	1.5
0.400	1.3	38.3	46.7	-85.0	0.54	1.8
0.490	0.9	20.1	50.6	-70.7	0.58	1.9
0.500	0.9	18.6	50.9	-69.6	0.58	1.9
0.600	0.5	7.4	53.8	-61.2	0.62	2.0
0.700	0.2	1.7	55.4	-57.0	0.64	2.1
0.790		0.0	55.8	-55.8	0.64	2.1
0.800						
0.900						
1.000						
1.100						
1.200						

Drops Horizontally into the Pool

Height of COM	h = 0.66	m	
Mass of Person	m = 43.54	kg =	96 lb
Density of Water	p_w = 1000.00	kg/m^3	
Density of Person	p_B = 980.00	kg/m^3	
Cross-Sectional Area	A = 0.45	m^2 =	4.8125 ft^2
Length of Person	L = 0.30	m =	1 ft
Volume of Person	V = 0.33	m^3	
Coefficient of Drag	C_D = 1.00		
Gravitational Constant	g = 9.81	m/s^2	

Drag Force Equation $$F_D = \frac{1}{2} C_D A p_w v^2$$

Bouyancy Equation $$F_B = Vg(p_w - p_B)$$

Initial Conditions		
t_o =	0	s
v_o =	3.157	mph

ELAPSED TIME (s)	**VELOCITY AT TIME (mph)**	DRAG FORCE (N)	BOUYANCY FORCE (N)	NET FORCE (N)	DISTANCE (m)	**TOTAL DEPTH (ft)**
0	**7.1**				0.0	**0.0**
0.100	2.4	306.2	39.4	-345.6	0.19	0.6
0.200	1.4	91.0	57.0	-148.0	0.27	0.9
0.300	0.8	29.3	67.0	-96.3	0.32	1.0
0.400	0.3	6.0	72.2	-78.2	0.34	1.1
0.490		0.0	73.6	-73.6	0.35	1.2
0.500						
0.600						
0.700						
0.790						
0.800						
0.900						
1.000						
1.100						
1.200						

12-year-old Girl Calculations

Drops Vertically into the Pool

Height of COM	h = 1.22	m	
Mass of Person	m = 32.65	kg =	72 lb
Density of Water	p_w = 1000.00	kg/m^3	
Density of Person	p_B = 980.00	kg/m^3	
Cross-Sectional Area	A = 0.09	m^2 =	1 ft^2
Length of Person	L = 1.42	m =	4.64583333 ft
Volume of Person	V = 0.33	m^3	
Coefficient of Drag	C_D = 1.00		
Gravitational Constant	g = 9.81	m/s^2	

Drag Force Equation $$F_D = \frac{1}{2} C_D A p_w v^2$$

Bouyancy Equation $$F_B = Vg(p_w - p_B)$$

Initial Conditions		
t_o =	0	s
v_o =	3.157	mph

ELAPSED TIME (s)	**VELOCITY AT TIME (mph)**	DRAG FORCE (N)	BOUYANCY FORCE (N)	NET FORCE (N)	DISTANCE (m)	**TOTAL DEPTH (ft)**
0	**7.1**				0.0	**0.0**
0.100	4.8	226.5	11.9	-238.4	0.26	0.9
0.200	3.5	123.3	20.3	-143.6	0.45	1.5
0.300	2.7	73.4	26.7	-100.1	0.59	1.9
0.400	2.2	45.2	31.7	-76.8	0.70	2.3
0.500	1.7	27.6	35.6	-63.2	0.79	2.6
0.600	1.3	16.2	38.6	-54.8	0.85	2.8
0.660	1.1	11.3	40.0	-51.3	0.89	2.9
0.700	0.9	8.6	40.8	-49.4	0.91	3.0
0.800	0.6	3.7	42.4	-46.2	0.94	3.1
0.860	0.4	1.9	43.0	-44.9	0.95	3.1
0.900	0.3	1.0	43.3	-44.3	0.96	3.2
1.000		0.0	43.7	-43.7	0.97	3.2

Drops Diagonally into the Pool

Height of COM	h = 1.01	m	
Mass of Person	m = 32.65	kg =	72 lb
Density of Water	p_w = 1000.00	kg/m^3	
Density of Person	p_B = 980.00	kg/m^3	
Cross-Sectional Area	A = 0.09	m^2 =	1 ft^2
Length of Person	L = 1.00	m =	3.28510025 ft
Volume of Person	V = 0.33	m^3	
Coefficient of Drag	C_D = 1.00		
Gravitational Constant	g = 9.81	m/s^2	

Drag Force Equation $F_D = \frac{1}{2} C_D A p_w v^2$

Bouyancy Equation $F_B = Vg(p_w - p_B)$

Initial Conditions		
t_o =	0	s
v_o =	3.157	mph

ELAPSED TIME (s)	**VELOCITY AT TIME (mph)**	DRAG FORCE (N)	BOUYANCY FORCE (N)	NET FORCE (N)	DISTANCE (m)	**TOTAL DEPTH (ft)**
0	**7.1**				0.0	**0.0**
0.100	4.8	225.3	16.8	-242.1	0.26	0.9
0.200	3.5	120.3	28.6	-149.0	0.45	1.5
0.300	2.7	69.1	37.4	-106.5	0.59	1.9
0.400	2.0	39.9	44.2	-84.1	0.69	2.3
0.500	1.5	22.1	49.2	-71.3	0.77	2.5
0.600	1.0	10.8	52.9	-63.7	0.83	2.7
0.660	0.8	6.3	54.5	-60.7	0.85	2.8
0.700	0.6	4.0	55.3	-59.3	0.87	2.8
0.800	0.2	0.6	56.5	-57.2	0.89	2.9
0.860		0.0	56.7	-56.8	0.89	2.9
0.900						
1.000						

Drops with Tucked Knees into the Pool

Height of COM	$h = 0.86$	m	
Mass of Person	$m = 32.65$	kg =	72 lb
Density of Water	$p_w = 1000.00$	kg/m^3	
Density of Person	$p_B = 980.00$	kg/m^3	
Cross-Sectional Area	$A = 0.22$	m^2 =	2.322917 ft^2
Length of Person	$L = 0.71$	m =	2.32291667 ft
Volume of Person	$V = 0.33$	m^3	
Coefficient of Drag	$C_D = 1.00$		
Gravitational Constant	$g = 9.81$	m/s^2	

Drag Force Equation $F_D = \frac{1}{2} C_D A p_w v^2$

Bouyancy Equation $F_B = Vg(p_w - p_B)$

Initial Conditions		
$t_o =$	0	s
$v_o =$	3.157	mph

ELAPSED TIME (s)	**VELOCITY AT TIME (mph)**	DRAG FORCE (N)	BOUYANCY FORCE (N)	NET FORCE (N)	DISTANCE (m)	**TOTAL DEPTH (ft)**
0	**7.1**				0.0	**0.0**
0.100	3.3	257.3	19.7	-277.1	0.22	0.7
0.200	2.0	97.6	30.3	-127.9	0.34	1.1
0.300	1.4	43.5	37.2	-80.8	0.41	1.4
0.400	0.9	19.0	41.9	-60.8	0.46	1.5
0.500	0.5	6.6	44.8	-51.4	0.50	1.6
0.600	0.2	1.0	46.3	-47.3	0.51	1.7
0.660		0.0	46.5	-46.5	0.52	1.7
0.700						
0.800						
0.860						
0.900						
1.000						

Drops Horizontally into the Pool

Height of COM	$h = 0.66$	m	
Mass of Person	$m = 32.65$	kg =	72 lb
Density of Water	$p_w = 1000.00$	kg/m^3	
Density of Person	$p_B = 980.00$	kg/m^3	
Cross-Sectional Area	$A = 0.43$	m^2 =	4.645833 ft^2
Length of Person	$L = 0.30$	m =	1 ft
Volume of Person	$V = 0.33$	m^3	
Coefficient of Drag	$C_D = 1.00$		
Gravitational Constant	$g = 9.81$	m/s^2	

Drag Force Equation $$F_D = \frac{1}{2} C_D A p_w v^2$$

Bouyancy Equation $$F_B = Vg(p_w - p_B)$$

Initial Conditions		
t_o =	0	s
v_o =	3.157	mph

ELAPSED TIME (s)	**VELOCITY AT TIME (mph)**	DRAG FORCE (N)	BOUYANCY FORCE (N)	NET FORCE (N)	DISTANCE (m)	**TOTAL DEPTH (ft)**
0	**7.1**				0.0	**0.0**
0.100	2.0	202.6	35.5	-238.1	0.17	0.6
0.200	1.0	51.0	49.5	-100.5	0.24	0.8
0.300	0.5	11.7	56.6	-68.3	0.27	0.9
0.400	0.0	0.3	59.2	-59.5	0.28	0.9
0.500						
0.600						
0.660						
0.700						
0.800						
0.860						
0.900						
1.000						

Drops Vertically into the Pool

Height of COM	$h = 1.26$	m	
Mass of Person	$m = 41.72$	kg =	92 lb
Density of Water	$p_w = 1000.00$	kg/m^3	
Density of Person	$p_B = 980.00$	kg/m^3	
Cross-Sectional Area	$A = 0.09$	$m^2 =$	1 ft^2
Length of Person	$L = 1.51$	m =	4.95833333 ft
Volume of Person	$V = 0.33$	m^3	
Coefficient of Drag	$C_D = 1.00$		
Gravitational Constant	$g = 9.81$	m/s^2	

Drag Force Equation $$F_D = \frac{1}{2} C_D A p_w v^2$$

Bouyancy Equation $$F_B = Vg(p_w - p_B)$$

Initial Conditions		
$t_o =$	0	s
$v_o =$	3.157	mph

ELAPSED TIME (s)	**VELOCITY AT TIME (mph)**	DRAG FORCE (N)	BOUYANCY FORCE (N)	NET FORCE (N)	DISTANCE (m)	**TOTAL DEPTH (ft)**
0	**7.1**				0.0	**0.0**
0.100	5.2	260.6	11.5	-272.2	0.27	0.9
0.200	4.0	156.2	20.2	-176.4	0.48	1.6
0.300	3.2	100.3	27.1	-127.4	0.64	2.1
0.400	2.6	66.6	32.7	-99.2	0.77	2.5
0.480	2.2	48.3	36.4	-84.7	0.86	2.8
0.500	2.1	44.6	37.2	-81.8	0.88	2.9
0.600	1.7	29.5	40.9	-70.4	0.97	3.2
0.700	1.4	18.9	43.9	-62.7	1.04	3.4
0.780	1.1	12.6	45.8	-58.4	1.08	3.6
0.800	1.1	11.3	46.2	-57.5	1.09	3.6
0.900	0.8	6.0	48.0	-54.0	1.14	3.7
1.000	0.5	2.5	49.2	-51.7	1.16	3.8
1.100	0.2	0.6	49.9	-50.5	1.18	3.9
1.190		0.0	50.1	-50.1	1.19	3.9

Drops Diagonally into the Pool

Height of COM	h = 1.04	m	
Mass of Person	m = 41.72	kg =	92 lb
Density of Water	p_w = 1000.00	kg/m^3	
Density of Person	p_B = 980.00	kg/m^3	
Cross-Sectional Area	A = 0.09	m^2 =	1 ft^2
Length of Person	L = 1.07	m =	3.50607112 ft
Volume of Person	V = 0.33	m^3	
Coefficient of Drag	C_D = 1.00		
Gravitational Constant	g = 9.81	m/s^2	

Drag Force Equation $F_D = \frac{1}{2} C_D A p_w v^2$

Bouyancy Equation $F_B = Vg(p_w - p_B)$

Initial Conditions		
t_o =	0	s
v_o =	3.157	mph

ELAPSED TIME (s)	**VELOCITY AT TIME (mph)**	DRAG FORCE (N)	BOUYANCY FORCE (N)	NET FORCE (N)	DISTANCE (m)	**TOTAL DEPTH (ft)**
0	**7.1**				0.0	**0.0**
0.100	5.1	259.6	16.3	-275.9	0.27	0.9
0.200	4.0	153.5	28.5	-182.0	0.48	1.6
0.300	3.1	96.1	38.1	-134.3	0.64	2.1
0.400	2.5	61.3	45.7	-107.1	0.76	2.5
0.480	2.1	42.5	50.7	-93.2	0.85	2.8
0.500	2.0	38.6	51.8	-90.4	0.87	2.8
0.600	1.5	23.3	56.6	-79.8	0.95	3.1
0.700	1.1	12.8	60.2	-72.9	1.01	3.3
0.780	0.8	7.0	62.3	-69.3	1.04	3.4
0.800	0.8	5.8	62.7	-68.6	1.05	3.4
0.900	0.4	1.7	64.3	-66.1	1.08	3.5
1.000	0.0	0.1	65.0	-65.0	1.09	3.6
1.100						
1.190						

Drops with Tucked Knees into the Pool

Height of COM	h = 0.89	m	
Mass of Person	m = 41.72	kg =	92 lb
Density of Water	p_w = 1000.00	kg/m^3	
Density of Person	p_B = 980.00	kg/m^3	
Cross-Sectional Area	A = 0.23	m^2 =	2.479167 ft^2
Length of Person	L = 0.76	m =	2.47916667 ft
Volume of Person	V = 0.33	m^3	
Coefficient of Drag	C_D = 1.00		
Gravitational Constant	g = 9.81	m/s^2	

Drag Force Equation $$F_D = \frac{1}{2} C_D A p_w v^2$$

Bouyancy Equation $$F_B = Vg(p_w - p_B)$$

Initial Conditions		
t_o =	0	s
v_o =	3.157	mph

ELAPSED TIME (s)	**VELOCITY AT TIME (mph)**	DRAG FORCE (N)	BOUYANCY FORCE (N)	NET FORCE (N)	DISTANCE (m)	**TOTAL DEPTH (ft)**
0	**7.1**				0.0	**0.0**
0.100	3.6	332.4	19.4	-351.8	0.23	0.8
0.200	2.4	138.5	30.7	-169.2	0.36	1.2
0.300	1.7	68.2	38.3	-106.5	0.45	1.5
0.400	1.2	34.7	43.7	-78.4	0.52	1.7
0.480	0.9	19.3	46.9	-66.2	0.55	1.8
0.500	0.8	16.5	47.6	-64.0	0.56	1.8
0.600	0.5	6.3	50.1	-56.4	0.59	1.9
0.700	0.2	1.2	51.4	-52.7	0.61	2.0
0.780		0.0	51.8	-51.8	0.61	2.0
0.800						
0.900						
1.000						
1.100						
1.190						

Drops Horizontally into the Pool

Height of COM	h = 0.66	m	
Mass of Person	m = 41.72	kg =	92 lb
Density of Water	p_w = 1000.00	kg/m^3	
Density of Person	p_B = 980.00	kg/m^3	
Cross-Sectional Area	A = 0.46	m^2 =	4.958333 ft^2
Length of Person	L = 0.30	m =	1 ft
Volume of Person	V = 0.33	m^3	
Coefficient of Drag	C_D = 1.00		
Gravitational Constant	g = 9.81	m/s^2	

Drag Force Equation $$F_D = \frac{1}{2} C_D A p_w v^2$$

Bouyancy Equation $$F_B = Vg(p_w - p_B)$$

Initial Conditions		
t_o =	0	s
v_o =	3.157	mph

ELAPSED TIME (s)	**VELOCITY AT TIME (mph)**	DRAG FORCE (N)	BOUYANCY FORCE (N)	NET FORCE (N)	DISTANCE (m)	**TOTAL DEPTH (ft)**
0	**7.1**				0.0	**0.0**
0.100	2.3	285.1	38.3	-323.4	0.18	0.6
0.200	1.3	81.9	54.9	-136.8	0.26	0.9
0.300	0.7	25.1	64.1	-89.2	0.31	1.0
0.400	0.3	4.3	68.7	-73.1	0.33	1.1
0.480		0.0	69.7	-69.7	0.33	1.1
0.500						
0.600						
0.700						
0.780						
0.800						
0.900						
1.000						
1.100						
1.190						

Drops Vertically into the Pool

Height of COM	h = 1.31	m	
Mass of Person	m = 55.33	kg =	122 lb
Density of Water	p_w = 1000.00	kg/m^3	
Density of Person	p_B = 980.00	kg/m^3	
Cross-Sectional Area	A = 0.09	m^2 =	1 ft^2
Length of Person	L = 1.61	m =	5.27083333 ft
Volume of Person	V = 0.33	m^3	
Coefficient of Drag	C_D = 1.00		
Gravitational Constant	g = 9.81	m/s^2	

Drag Force Equation $$F_D = \frac{1}{2} C_D A p_w v^2$$

Bouyancy Equation $$F_B = Vg(p_w - p_B)$$

Initial Conditions		
t_o =	0	s
v_o =	3.157	mph

ELAPSED TIME (s)	**VELOCITY AT TIME (mph)**	DRAG FORCE (N)	BOUYANCY FORCE (N)	NET FORCE (N)	DISTANCE (m)	**TOTAL DEPTH (ft)**
0	**7.1**				0.0	**0.0**
0.100	5.5	297.0	11.2	-308.2	0.28	0.9
0.200	4.5	196.1	20.2	-216.3	0.51	1.7
0.300	3.8	135.9	27.6	-163.5	0.69	2.3
0.400	3.2	96.8	33.8	-130.6	0.85	2.8
0.500	2.7	69.9	39.0	-108.9	0.98	3.2
0.550	2.5	59.5	41.4	-100.8	1.04	3.4
0.600	2.3	50.5	43.5	-94.0	1.09	3.6
0.700	1.9	36.1	47.3	-83.4	1.19	3.9
0.800	1.6	25.3	50.5	-75.8	1.27	4.2
0.900	1.3	17.0	53.1	-70.2	1.34	4.4
0.930	1.2	15.0	53.8	-68.8	1.35	4.4
1.000	1.1	10.8	55.3	-66.1	1.39	4.6
1.100	0.8	6.2	56.9	-63.1	1.43	4.7
1.200	0.5	3.0	58.1	-61.1	1.46	4.8
1.230	0.5	2.3	58.4	-60.6	1.47	4.8
1.300	0.3	1.0	58.9	-59.9	1.48	4.9
1.400	0.1	0.1	59.2	-59.3	1.49	4.9
1.430		0.0	59.2	-59.2	1.49	4.9

Drops Diagonally into the Pool

Height of COM	h = 1.08	m	
Mass of Person	m = 55.33	kg =	122 lb
Density of Water	p_w = 1000.00	kg/m^3	
Density of Person	p_B = 980.00	kg/m^3	
Cross-Sectional Area	A = 0.09	m^2 =	1 ft^2
Length of Person	L = 1.14	m =	3.72704199 ft
Volume of Person	V = 0.33	m^3	
Coefficient of Drag	C_D = 1.00		
Gravitational Constant	g = 9.81	m/s^2	

Drag Force Equation $$F_D = \frac{1}{2} C_D A p_w v^2$$

Bouyancy Equation $$F_B = V g (p_w - p_B)$$

Initial Conditions		
t_o =	0	s
v_o =	3.157	mph

ELAPSED TIME (s)	**VELOCITY AT TIME (mph)**	DRAG FORCE (N)	BOUYANCY FORCE (N)	NET FORCE (N)	DISTANCE (m)	**TOTAL DEPTH (ft)**
0	**7.1**				0.0	**0.0**
0.100	5.5	296.1	15.9	-312.0	0.28	0.9
0.200	4.5	193.7	28.5	-222.2	0.51	1.7
0.300	3.7	132.1	38.8	-170.9	0.69	2.3
0.400	3.1	91.7	47.4	-139.2	0.84	2.8
0.500	2.6	63.8	54.6	-118.4	0.97	3.2
0.550	2.3	53.0	57.7	-110.7	1.03	3.4
0.600	2.1	43.7	60.5	-104.3	1.08	3.5
0.700	1.7	29.0	65.4	-94.4	1.16	3.8
0.800	1.4	18.2	69.4	-87.5	1.23	4.0
0.900	1.0	10.3	72.4	-82.7	1.29	4.2
0.930	0.9	8.5	73.2	-81.6	1.30	4.3
1.000	0.7	4.9	74.6	-79.5	1.33	4.4
1.100	0.4	1.6	76.0	-77.5	1.35	4.4
1.200	0.1	0.1	76.6	-76.7	1.36	4.5
1.230		0.0	76.6	-76.6	1.36	4.5
1.300						
1.400						
1.430						

Drops with Tucked Knees into the Pool

Height of COM	$h = 0.91$	m	
Mass of Person	$m = 55.33$	kg =	122 lb
Density of Water	$p_w = 1000.00$	kg/m^3	
Density of Person	$p_B = 980.00$	kg/m^3	
Cross-Sectional Area	$A = 0.24$	m^2 =	2.635417 ft^2
Length of Person	$L = 0.80$	m =	2.63541667 ft
Volume of Person	$V = 0.33$	m^3	
Coefficient of Drag	$C_D = 1.00$		
Gravitational Constant	$g = 9.81$	m/s^2	

Drag Force Equation $$F_D = \frac{1}{2} C_D A p_w v^2$$

Bouyancy Equation $$F_B = Vg(p_w - p_B)$$

Initial Conditions		
t_o =	0	s
v_o =	3.157	mph

ELAPSED TIME (s)	**VELOCITY AT TIME (mph)**	DRAG FORCE (N)	BOUYANCY FORCE (N)	NET FORCE (N)	DISTANCE (m)	**TOTAL DEPTH (ft)**
0	**7.1**				0.0	**0.0**
0.100	4.0	433.7	19.3	-453.0	0.24	0.8
0.200	2.8	200.5	31.3	-231.8	0.39	1.3
0.300	2.0	108.0	39.9	-147.9	0.50	1.6
0.400	1.5	61.4	46.3	-107.8	0.58	1.9
0.500	1.2	34.8	51.2	-86.0	0.64	2.1
0.550	1.0	25.7	53.1	-78.8	0.67	2.2
0.600	0.8	18.5	54.8	-73.3	0.69	2.3
0.700	0.6	8.5	57.3	-65.8	0.72	2.4
0.800	0.3	2.7	58.9	-61.6	0.74	2.4
0.900	0.1	0.2	59.6	-59.8	0.75	2.5
0.930		0.0	59.6	-59.6	0.75	2.5
1.000						
1.100						
1.200						
1.230						
1.300						
1.400						
1.430						

Drops Horizontally into the Pool

Height of COM	h = 0.66	m	
Mass of Person	m = 55.33	kg =	122 lb
Density of Water	p_w = 1000.00	kg/m^3	
Density of Person	p_B = 980.00	kg/m^3	
Cross-Sectional Area	A = 0.49	m^2 =	5.270833 ft^2
Length of Person	L = 0.30	m =	1 ft
Volume of Person	V = 0.33	m^3	
Coefficient of Drag	C_D = 1.00		
Gravitational Constant	g = 9.81	m/s^2	

Drag Force Equation $$F_D = \frac{1}{2} C_D A p_w v^2$$

Bouyancy Equation $$F_B = Vg(p_w - p_B)$$

Initial Conditions		
t_o =	0	s
v_o =	3.157	mph

ELAPSED TIME (s)	**VELOCITY AT TIME (mph)**	DRAG FORCE (N)	BOUYANCY FORCE (N)	NET FORCE (N)	DISTANCE (m)	**TOTAL DEPTH (ft)**
0	**7.1**				0.0	**0.0**
0.100	2.7	411.5	41.6	-453.1	0.20	0.7
0.200	1.6	134.8	61.6	-196.4	0.29	1.0
0.300	1.0	51.0	73.6	-124.6	0.35	1.2
0.400	0.5	16.2	80.8	-97.0	0.39	1.3
0.500	0.2	2.1	84.3	-86.4	0.40	1.3
0.550		0.1	84.8	-84.8	0.40	1.3
0.600						
0.700						
0.800						
0.900						
0.930						
1.000						
1.100						
1.200						
1.230						
1.300						
1.400						
1.430						

14-year-old Girl Calculations

Drops Vertically into the Pool

Height of COM	h = 1.27	m	
Mass of Person	m = 39.46	kg =	87 lb
Density of Water	p_w = 1000.00	kg/m^3	
Density of Person	p_B = 980.00	kg/m^3	
Cross-Sectional Area	A = 0.09	m^2 =	1 ft^2
Length of Person	L = 1.52	m =	4.97916667 ft
Volume of Person	V = 0.33	m^3	
Coefficient of Drag	C_D = 1.00		
Gravitational Constant	g = 9.81	m/s^2	

Drag Force Equation $$F_D = \frac{1}{2} C_D A p_w v^2$$

Bouyancy Equation $$F_B = Vg(p_w - p_B)$$

Initial Conditions		
t_o =	0	s
v_o =	3.157	mph

ELAPSED TIME (s)	**VELOCITY AT TIME (mph)**	DRAG FORCE (N)	BOUYANCY FORCE (N)	NET FORCE (N)	DISTANCE (m)	**TOTAL DEPTH (ft)**
0	**7.1**				0.0	**0.0**
0.100	5.1	253.1	11.4	-264.5	0.27	0.9
0.200	3.9	148.6	19.9	-168.5	0.47	1.6
0.300	3.1	94.0	26.5	-120.5	0.63	2.1
0.400	2.5	61.5	31.9	-93.4	0.76	2.5
0.460	2.2	48.0	34.6	-82.5	0.82	2.7
0.500	2.0	40.6	36.2	-76.8	0.86	2.8
0.600	1.6	26.4	39.7	-66.1	0.94	3.1
0.700	1.3	16.4	42.5	-58.9	1.01	3.3
0.750	1.1	12.6	43.7	-56.3	1.04	3.4
0.800	1.0	9.5	44.7	-54.1	1.06	3.5
0.900	0.7	4.7	46.2	-50.9	1.10	3.6
0.990	0.4	1.9	47.2	-49.1	1.12	3.7
1.000	0.4	1.7	47.3	-49.0	1.12	3.7
1.100	0.1	0.2	47.8	-48.0	1.14	3.7
1.150		0.0	47.9	-47.9	1.14	3.7

Drops Diagonally into the Pool

Height of COM	$h = 1.04$	m	
Mass of Person	$m = 39.46$	kg =	87 lb
Density of Water	$p_w = 1000.00$	kg/m^3	
Density of Person	$p_B = 980.00$	kg/m^3	
Cross-Sectional Area	$A = 0.09$	m^2 =	1 ft^2
Length of Person	$L = 1.07$	m =	3.52080251 ft
Volume of Person	$V = 0.33$	m^3	
Coefficient of Drag	$C_D = 1.00$		
Gravitational Constant	$g = 9.81$	m/s^2	

Drag Force Equation $$F_D = \frac{1}{2} C_D A p_w v^2$$

Bouyancy Equation $$F_B = Vg(p_w - p_B)$$

Initial Conditions		
t_o =	0	s
v_o =	3.157	mph

ELAPSED TIME (s)	**VELOCITY AT TIME (mph)**	DRAG FORCE (N)	BOUYANCY FORCE (N)	NET FORCE (N)	DISTANCE (m)	**TOTAL DEPTH (ft)**
0	**7.1**				0.0	**0.0**
0.100	5.1	252.0	16.1	-268.2	0.27	0.9
0.200	3.9	145.9	28.1	-173.9	0.47	1.5
0.300	3.0	89.9	37.3	-127.1	0.63	2.1
0.400	2.4	56.3	44.6	-100.9	0.75	2.5
0.460	2.1	42.3	48.2	-90.6	0.81	2.7
0.500	1.9	34.8	50.4	-85.1	0.85	2.8
0.600	1.4	20.3	54.8	-75.2	0.92	3.0
0.700	1.0	10.7	58.2	-68.8	0.98	3.2
0.750	0.8	7.2	59.4	-66.6	1.00	3.3
0.800	0.7	4.4	60.5	-64.9	1.02	3.3
0.900	0.3	1.0	61.8	-62.8	1.04	3.4
0.990		0.0	62.1	-62.1	1.04	3.4
1.000						
1.100						
1.150						

Drops with Tucked Knees into the Pool

Height of COM	h = 0.89	m	
Mass of Person	m = 39.46	kg =	87 lb
Density of Water	p_w = 1000.00	kg/m^3	
Density of Person	p_B = 980.00	kg/m^3	
Cross-Sectional Area	A = 0.23	m^2 =	2.489583 ft^2
Length of Person	L = 0.76	m =	2.48958333 ft
Volume of Person	V = 0.33	m^3	
Coefficient of Drag	C_D = 1.00		
Gravitational Constant	g = 9.81	m/s^2	

Drag Force Equation $$F_D = \frac{1}{2} C_D A p_w v^2$$

Bouyancy Equation $$F_B = V g (p_w - p_B)$$

Initial Conditions		
t_o =	0	s
v_o =	3.157	mph

ELAPSED TIME (s)	**VELOCITY AT TIME (mph)**	DRAG FORCE (N)	BOUYANCY FORCE (N)	NET FORCE (N)	DISTANCE (m)	**TOTAL DEPTH (ft)**
0	**7.1**				0.0	**0.0**
0.100	3.5	314.3	19.0	-333.4	0.23	0.7
0.200	2.3	127.6	29.8	-157.4	0.35	1.2
0.300	1.6	61.5	37.1	-98.6	0.44	1.4
0.400	1.1	30.5	42.2	-72.6	0.50	1.6
0.460	0.9	19.3	44.4	-63.8	0.53	1.7
0.500	0.7	13.8	45.7	-59.5	0.54	1.8
0.600	0.4	4.8	47.9	-52.7	0.57	1.9
0.700	0.1	0.6	49.0	-49.7	0.58	1.9
0.750		0.0	49.2	-49.2	0.58	1.9
0.800						
0.900						
0.990						
1.000						
1.100						
1.150						

Drops Horizontally into the Pool

Height of COM	h = 0.66	m	
Mass of Person	m = 39.46	kg =	87 lb
Density of Water	p_w = 1000.00	kg/m^3	
Density of Person	p_B = 980.00	kg/m^3	
Cross-Sectional Area	A = 0.46	m^2 =	4.979167 ft^2
Length of Person	L = 0.30	m =	1 ft
Volume of Person	V = 0.33	m^3	
Coefficient of Drag	C_D = 1.00		
Gravitational Constant	g = 9.81	m/s^2	

Drag Force Equation $$F_D = \frac{1}{2} C_D A p_w v^2$$

Bouyancy Equation $$F_B = Vg(p_w - p_B)$$

Initial Conditions		
t_o =	0	s
v_o =	3.157	mph

ELAPSED TIME (s)	**VELOCITY AT TIME (mph)**	DRAG FORCE (N)	BOUYANCY FORCE (N)	NET FORCE (N)	DISTANCE (m)	**TOTAL DEPTH (ft)**
0	**7.1**				0.0	**0.0**
0.100	2.2	262.2	37.4	-299.6	0.18	0.6
0.200	1.2	72.8	53.1	-125.9	0.25	0.8
0.300	0.6	21.0	61.7	-82.7	0.29	1.0
0.400	0.2	2.9	65.7	-68.6	0.31	1.0
0.460		0.0	66.4	-66.4	0.32	1.0
0.500						
0.600						
0.700						
0.750						
0.800						
0.900						
0.990						
1.000						
1.100						
1.150						

Drops Vertically into the Pool

Height of COM	h = 1.31	m	
Mass of Person	m = 48.98	kg =	108 lb
Density of Water	p_w = 1000.00	kg/m^3	
Density of Person	p_B = 980.00	kg/m^3	
Cross-Sectional Area	A = 0.09	m^2 =	1 ft^2
Length of Person	L = 1.61	m =	5.27083333 ft
Volume of Person	V = 0.33	m^3	
Coefficient of Drag	C_D = 1.00		
Gravitational Constant	g = 9.81	m/s^2	

Drag Force Equation $F_D = \frac{1}{2} C_D A p_w v^2$

Bouyancy Equation $F_B = Vg(p_w - p_B)$

Initial Conditions		
t_o =	0	s
v_o =	3.157	mph

ELAPSED TIME (s)	**VELOCITY AT TIME (mph)**	DRAG FORCE (N)	BOUYANCY FORCE (N)	NET FORCE (N)	DISTANCE (m)	**TOTAL DEPTH (ft)**
0	**7.1**				0.0	**0.0**
0.100	5.4	281.8	11.1	-292.9	0.28	0.9
0.200	4.3	178.8	19.7	-198.6	0.50	1.6
0.300	3.5	120.2	26.7	-147.0	0.67	2.2
0.400	2.9	83.4	32.5	-115.9	0.82	2.7
0.500	2.5	58.6	37.3	-95.9	0.94	3.1
0.600	2.1	41.1	41.4	-82.5	1.04	3.4
0.700	1.7	28.3	44.8	-73.1	1.13	3.7
0.800	1.4	18.9	47.6	-66.5	1.20	3.9
0.870	1.2	13.8	49.2	-63.0	1.24	4.1
0.900	1.1	11.9	49.8	-61.8	1.25	4.1
1.000	0.8	6.9	51.6	-58.4	1.30	4.3
1.100	0.6	3.3	52.8	-56.2	1.33	4.4
1.150	0.4	2.1	53.3	-55.4	1.34	4.4
1.200	0.3	1.1	53.7	-54.8	1.35	4.4
1.300	0.1	0.1	54.0	-54.1	1.36	4.5
1.330		0.0	54.0	-54.0	1.36	4.5

Drops Diagonally into the Pool

Height of COM	h = 1.08	m	
Mass of Person	m = 48.98	kg =	108 lb
Density of Water	p_w = 1000.00	kg/m^3	
Density of Person	p_B = 980.00	kg/m^3	
Cross-Sectional Area	A = 0.09	m^2 =	1 ft^2
Length of Person	L = 1.14	m =	3.72704199 ft
Volume of Person	V = 0.33	m^3	
Coefficient of Drag	C_D = 1.00		
Gravitational Constant	g = 9.81	m/s^2	

Drag Force Equation $$F_D = \frac{1}{2} C_D A p_w v^2$$

Bouyancy Equation $$F_B = Vg(p_w - p_B)$$

Initial Conditions		
t_o =	0	s
v_o =	3.157	mph

ELAPSED TIME (s)	**VELOCITY AT TIME (mph)**	DRAG FORCE (N)	BOUYANCY FORCE (N)	NET FORCE (N)	DISTANCE (m)	**TOTAL DEPTH (ft)**
0	**7.1**				0.0	**0.0**
0.100	5.4	280.9	15.7	-296.6	0.28	0.9
0.200	4.3	176.4	27.8	-204.2	0.49	1.6
0.300	3.5	116.3	37.6	-154.0	0.67	2.2
0.400	2.8	78.3	45.6	-123.9	0.81	2.7
0.500	2.3	52.6	52.2	-104.8	0.93	3.0
0.600	1.9	34.6	57.5	-92.1	1.02	3.4
0.700	1.5	21.7	61.8	-83.5	1.10	3.6
0.800	1.1	12.5	65.1	-77.6	1.16	3.8
0.870	0.9	7.8	66.9	-74.7	1.19	3.9
0.900	0.8	6.2	67.6	-73.7	1.20	3.9
1.000	0.5	2.2	69.1	-71.3	1.23	4.0
1.100	0.1	0.2	69.9	-70.2	1.24	4.1
1.150		0.0	70.0	-70.0	1.24	4.1
1.200						
1.300						
1.330						

Drops with Tucked Knees into the Pool

Height of COM	h = 0.91	m	
Mass of Person	m = 48.98	kg =	108 lb
Density of Water	p_w = 1000.00	kg/m^3	
Density of Person	p_B = 980.00	kg/m^3	
Cross-Sectional Area	A = 0.24	m^2 =	2.635417 ft^2
Length of Person	L = 0.80	m =	2.63541667 ft
Volume of Person	V = 0.33	m^3	
Coefficient of Drag	C_D = 1.00		
Gravitational Constant	g = 9.81	m/s^2	

Drag Force Equation $$F_D = \frac{1}{2} C_D A p_w v^2$$

Bouyancy Equation $$F_B = Vg(p_w - p_B)$$

Initial Conditions		
t_o =	0	s
v_o =	3.157	mph

ELAPSED TIME (s)	**VELOCITY AT TIME (mph)**	DRAG FORCE (N)	BOUYANCY FORCE (N)	NET FORCE (N)	DISTANCE (m)	**TOTAL DEPTH (ft)**
0	**7.1**				0.0	**0.0**
0.100	3.8	389.3	18.7	-408.0	0.24	0.8
0.200	2.6	170.8	30.0	-200.8	0.38	1.2
0.300	1.8	88.5	37.8	-126.3	0.48	1.6
0.400	1.4	48.3	43.6	-91.9	0.55	1.8
0.500	1.0	25.8	47.8	-73.6	0.60	2.0
0.600	0.7	12.5	50.8	-63.3	0.64	2.1
0.700	0.4	4.7	52.8	-57.5	0.66	2.2
0.800	0.2	0.8	53.9	-54.7	0.68	2.2
0.870		0.0	54.1	-54.1	0.68	2.2
0.900						
1.000						
1.100						
1.150						
1.200						
1.300						
1.330						

Drops Horizontally into the Pool

Height of COM	$h = 0.66$	m	
Mass of Person	$m = 48.98$	kg =	108 lb
Density of Water	$p_w = 1000.00$	kg/m^3	
Density of Person	$p_B = 980.00$	kg/m^3	
Cross-Sectional Area	$A = 0.49$	m^2 =	5.270833 ft^2
Length of Person	$L = 0.30$	m =	1 ft
Volume of Person	$V = 0.33$	m^3	
Coefficient of Drag	$C_D = 1.00$		
Gravitational Constant	$g = 9.81$	m/s^2	

Drag Force Equation $$F_D = \frac{1}{2} C_D A p_w v^2$$

Bouyancy Equation $$F_B = Vg(p_w - p_B)$$

Initial Conditions		
t_o =	0	s
v_o =	3.157	mph

ELAPSED TIME (s)	**VELOCITY AT TIME (mph)**	DRAG FORCE (N)	BOUYANCY FORCE (N)	NET FORCE (N)	DISTANCE (m)	**TOTAL DEPTH (ft)**
0	**7.1**				0.0	**0.0**
0.100	2.5	349.7	39.8	-389.6	0.19	0.6
0.200	1.4	107.6	57.9	-165.5	0.28	0.9
0.300	0.8	37.3	68.5	-105.8	0.33	1.1
0.400	0.4	9.6	74.4	-84.0	0.35	1.2
0.500	0.0	0.3	76.6	-76.9	0.37	1.2
0.600						
0.700						
0.800						
0.870						
0.900						
1.000						
1.100						
1.150						
1.200						
1.300						
1.330						

Drops Vertically into the Pool

Height of COM	h = 1.35	m	
Mass of Person	m = 65.31	kg =	144 lb
Density of Water	p_w = 1000.00	kg/m^3	
Density of Person	p_B = 980.00	kg/m^3	
Cross-Sectional Area	A = 0.09	m^2 =	1 ft^2
Length of Person	L = 1.69	m =	5.54166667 ft
Volume of Person	V = 0.33	m^3	
Coefficient of Drag	C_D = 1.00		
Gravitational Constant	g = 9.81	m/s^2	

Drag Force Equation $$F_D = \frac{1}{2} C_D A p_w v^2$$

Bouyancy Equation $$F_B = Vg(p_w - p_B)$$

Initial Conditions		
t_o =	0	s
v_o =	3.157	mph

ELAPSED TIME (s)	**VELOCITY AT TIME (mph)**	DRAG FORCE (N)	BOUYANCY FORCE (N)	NET FORCE (N)	DISTANCE (m)	**TOTAL DEPTH (ft)**
0	**7.1**				0.0	**0.0**
0.100	5.7	316.4	10.9	-327.3	0.29	0.9
0.200	4.8	219.8	19.8	-239.5	0.52	1.7
0.300	4.1	158.7	27.3	-186.0	0.72	2.4
0.400	3.5	117.3	33.7	-151.1	0.89	2.9
0.500	3.0	87.9	39.3	-127.2	1.04	3.4
0.600	2.6	66.1	44.1	-110.2	1.17	3.8
0.700	2.3	49.6	48.3	-97.9	1.28	4.2
0.800	2.0	36.8	51.9	-88.7	1.37	4.5
0.900	1.7	26.8	55.0	-81.8	1.45	4.8
1.000	1.4	18.9	57.6	-76.5	1.52	5.0
1.100	1.1	12.7	59.8	-72.5	1.58	5.2
1.200	0.9	8.0	61.5	-69.5	1.63	5.3
1.300	0.7	4.5	62.9	-67.3	1.66	5.5
1.380	0.5	2.4	63.7	-66.1	1.68	5.5
1.400	0.4	2.0	63.8	-65.8	1.69	5.5
1.500	0.2	0.5	64.4	-65.0	1.70	5.6
1.600		0.0	64.6	-64.6	1.71	5.6

Drops Diagonally into the Pool

Height of COM	h = 1.11	m	
Mass of Person	m = 65.31	kg =	144 lb
Density of Water	p_w = 1000.00	kg/m^3	
Density of Person	p_B = 980.00	kg/m^3	
Cross-Sectional Area	A = 0.09	m^2 =	1 ft^2
Length of Person	L = 1.19	m =	3.91855008 ft
Volume of Person	V = 0.33	m^3	
Coefficient of Drag	C_D = 1.00		
Gravitational Constant	g = 9.81	m/s^2	

Drag Force Equation $$F_D = \frac{1}{2} C_D A p_w v^2$$

Bouyancy Equation $$F_B = Vg(p_w - p_B)$$

Initial Conditions		
t_o =	0	s
v_o =	3.157	mph

ELAPSED TIME (s)	**VELOCITY AT TIME (mph)**	DRAG FORCE (N)	BOUYANCY FORCE (N)	NET FORCE (N)	DISTANCE (m)	**TOTAL DEPTH (ft)**
0	**7.1**				0.0	**0.0**
0.100	5.7	315.7	15.3	-331.1	0.29	0.9
0.200	4.8	217.7	27.9	-245.6	0.52	1.7
0.300	4.0	155.1	38.5	-193.6	0.72	2.4
0.400	3.4	112.5	47.4	-159.9	0.89	2.9
0.500	2.9	81.9	55.1	-137.0	1.03	3.4
0.600	2.5	59.3	61.6	-120.9	1.15	3.8
0.700	2.1	42.2	67.1	-109.3	1.25	4.1
0.800	1.7	29.1	71.7	-100.9	1.34	4.4
0.900	1.4	19.2	75.5	-94.7	1.41	4.6
1.000	1.1	11.6	78.5	-90.2	1.47	4.8
1.100	0.8	6.2	80.8	-87.0	1.51	5.0
1.200	0.5	2.5	82.4	-84.9	1.54	5.1
1.300	0.2	0.5	83.2	-83.7	1.56	5.1
1.380		0.0	83.4	-83.4	1.56	5.1
1.400						
1.500						
1.600						

Drops with Tucked Knees into the Pool

Height of COM	h = 0.93	m	
Mass of Person	m = 65.31	kg =	144 lb
Density of Water	p_w = 1000.00	kg/m^3	
Density of Person	p_B = 980.00	kg/m^3	
Cross-Sectional Area	A = 0.26	m^2 =	2.770833 ft^2
Length of Person	L = 0.84	m =	2.77083333 ft
Volume of Person	V = 0.33	m^3	
Coefficient of Drag	C_D = 1.00		
Gravitational Constant	g = 9.81	m/s^2	

Drag Force Equation $$F_D = \frac{1}{2} C_D A p_w v^2$$

Bouyancy Equation $$F_B = V g (p_w - p_B)$$

Initial Conditions		
t_o =	0	s
v_o =	3.157	mph

ELAPSED TIME (s)	**VELOCITY AT TIME (mph)**	DRAG FORCE (N)	BOUYANCY FORCE (N)	NET FORCE (N)	DISTANCE (m)	**TOTAL DEPTH (ft)**
0	**7.1**				0.0	**0.0**
0.100	4.2	502.0	18.8	-520.8	0.25	0.8
0.200	3.0	244.5	31.0	-275.5	0.41	1.3
0.300	2.3	137.5	39.9	-177.4	0.53	1.7
0.400	1.7	82.2	46.7	-128.9	0.62	2.0
0.500	1.4	49.8	52.0	-101.8	0.69	2.3
0.600	1.0	29.5	56.1	-85.6	0.74	2.4
0.700	0.8	16.2	59.2	-75.4	0.78	2.6
0.800	0.5	7.7	61.4	-69.1	0.81	2.7
0.900	0.3	2.6	62.8	-65.4	0.83	2.7
1.000	0.1	0.2	63.5	-63.7	0.84	2.8
1.100						
1.200						
1.300						
1.380						
1.400						
1.500						
1.600						

Drops Horizontally into the Pool

Height of COM	$h = 0.66$	m	
Mass of Person	$m = 65.31$	kg =	144 lb
Density of Water	$p_w = 1000.00$	kg/m^3	
Density of Person	$p_B = 980.00$	kg/m^3	
Cross-Sectional Area	$A = 0.51$	m^2 =	5.541667 ft^2
Length of Person	$L = 0.30$	m =	1 ft
Volume of Person	$V = 0.33$	m^3	
Coefficient of Drag	$C_D = 1.00$		
Gravitational Constant	$g = 9.81$	m/s^2	

Drag Force Equation $$F_D = \frac{1}{2} C_D A p_w v^2$$

Bouyancy Equation $$F_B = Vg(p_w - p_B)$$

Initial Conditions		
t_o =	0	s
v_o =	3.157	mph

ELAPSED TIME (s)	**VELOCITY AT TIME (mph)**	DRAG FORCE (N)	BOUYANCY FORCE (N)	NET FORCE (N)	DISTANCE (m)	**TOTAL DEPTH (ft)**
0	**7.1**				0.0	**0.0**
0.100	2.9	501.1	43.3	-544.4	0.21	0.7
0.200	1.8	175.2	65.2	-240.4	0.31	1.0
0.300	1.1	72.2	78.8	-151.0	0.38	1.2
0.400	0.7	27.5	87.5	-115.0	0.42	1.4
0.500	0.3	6.9	92.4	-99.3	0.44	1.4
0.600	0.0	0.1	94.1	-94.2	0.45	1.5
0.700						
0.800						
0.900						
1.000						
1.100						
1.200						
1.300						
1.380						
1.400						
1.500						
1.600						

10-year-old Boy Calculations

Drops Vertically into the Pool

Height of COM	h = 1.16	m	
Mass of Person	m = 26.30	kg =	58 lb
Density of Water	p_w = 1000.00	kg/m^3	
Density of Person	p_B = 980.00	kg/m^3	
Cross-Sectional Area	A = 0.09	m^2 =	1 ft^2
Length of Person	L = 1.30	m =	4.27083333 ft
Volume of Person	V = 0.33	m^3	
Coefficient of Drag	C_D = 1.00		
Gravitational Constant	g = 9.81	m/s^2	

Drag Force Equation $$F_D = \frac{1}{2} C_D A p_w v^2$$

Bouyancy Equation $$F_B = Vg(p_w - p_B)$$

Initial Conditions		
t_o =	0	s
v_o =	3.157	mph

ELAPSED TIME (s)	**VELOCITY AT TIME (mph)**	DRAG FORCE (N)	BOUYANCY FORCE (N)	NET FORCE (N)	DISTANCE (m)	**TOTAL DEPTH (ft)**
0	**7.1**				0.0	**0.0**
0.100	4.4	195.3	12.4	-207.7	0.25	0.8
0.200	3.1	96.7	20.7	-117.4	0.42	1.4
0.300	2.3	53.1	26.7	-79.9	0.54	1.8
0.370	1.9	35.5	30.0	-65.6	0.61	2.0
0.400	1.7	29.9	31.2	-61.1	0.64	2.1
0.500	1.3	16.1	34.6	-50.7	0.70	2.3
0.570	1.0	9.8	36.3	-46.2	0.74	2.4
0.600	0.9	7.7	37.0	-44.7	0.75	2.5
0.700	0.5	2.8	38.5	-41.3	0.79	2.6
0.730	0.4	1.8	38.8	-40.6	0.79	2.6
0.800	0.2	0.4	39.3	-39.7	0.80	2.6
0.860		0.0	39.4	-39.4	0.80	2.6

Drops Diagonally into the Pool

Height of COM	h = 0.97	m	
Mass of Person	m = 26.30	kg =	58 lb
Density of Water	p_w = 1000.00	kg/m^3	
Density of Person	p_B = 980.00	kg/m^3	
Cross-Sectional Area	A = 0.09	m^2 =	1 ft^2
Length of Person	L = 0.92	m =	3.01993521 ft
Volume of Person	V = 0.33	m^3	
Coefficient of Drag	C_D = 1.00		
Gravitational Constant	g = 9.81	m/s^2	

Drag Force Equation $F_D = \frac{1}{2} C_D A p_w v^2$

Bouyancy Equation $F_B = Vg(p_w - p_B)$

Initial Conditions		
t_o =	0	s
v_o =	3.157	mph

ELAPSED TIME (s)	**VELOCITY AT TIME (mph)**	DRAG FORCE (N)	BOUYANCY FORCE (N)	NET FORCE (N)	DISTANCE (m)	**TOTAL DEPTH (ft)**
0	**7.1**				0.0	**0.0**
0.100	4.4	193.8	17.6	-211.4	0.25	0.8
0.200	3.1	93.4	29.2	-122.6	0.42	1.4
0.300	2.2	48.7	37.4	-86.1	0.54	1.8
0.370	1.8	30.6	41.8	-72.4	0.60	2.0
0.400	1.6	24.8	43.4	-68.2	0.62	2.1
0.500	1.0	11.1	47.5	-58.6	0.68	2.2
0.570	0.7	5.3	49.5	-54.8	0.71	2.3
0.600	0.6	3.5	50.1	-53.6	0.72	2.4
0.700	0.1	0.3	51.2	-51.5	0.74	2.4
0.730		0.0	51.3	-51.3	0.74	2.4
0.800						
0.860						

Drops with Tucked Knees into the Pool

Height of COM	h = 0.83	m	
Mass of Person	m = 26.30	kg =	58 lb
Density of Water	p_w = 1000.00	kg/m^3	
Density of Person	p_B = 980.00	kg/m^3	
Cross-Sectional Area	A = 0.20	m^2 =	2.135417 ft^2
Length of Person	L = 0.65	m =	2.13541667 ft
Volume of Person	V = 0.33	m^3	
Coefficient of Drag	C_D = 1.00		
Gravitational Constant	g = 9.81	m/s^2	

Drag Force Equation $$F_D = \frac{1}{2} C_D A p_w v^2$$

Bouyancy Equation $$F_B = V g (p_w - p_B)$$

Initial Conditions		
t_o =	0	s
v_o =	3.157	mph

ELAPSED TIME (s)	**VELOCITY AT TIME (mph)**	DRAG FORCE (N)	BOUYANCY FORCE (N)	NET FORCE (N)	DISTANCE (m)	**TOTAL DEPTH (ft)**
0	**7.1**				0.0	**0.0**
0.100	3.0	202.2	20.6	-222.7	0.21	0.7
0.200	1.8	70.2	31.0	-101.3	0.32	1.0
0.300	1.1	27.8	37.5	-65.3	0.38	1.3
0.370	0.8	13.6	40.5	-54.0	0.41	1.4
0.400	0.6	9.5	41.5	-50.9	0.42	1.4
0.500	0.2	1.6	43.5	-45.1	0.44	1.5
0.570		0.0	43.9	-43.9	0.45	1.5
0.600						
0.700						
0.730						
0.800						
0.860						

Drops Horizontally into the Pool

Height of COM	$h = 0.66$	m	
Mass of Person	$m = 26.30$	kg =	58 lb
Density of Water	$p_w = 1000.00$	kg/m^3	
Density of Person	$p_B = 980.00$	kg/m^3	
Cross-Sectional Area	$A = 0.40$	m^2 =	4.270833 ft^2
Length of Person	$L = 0.30$	m =	1 ft
Volume of Person	$V = 0.33$	m^3	
Coefficient of Drag	$C_D = 1.00$		
Gravitational Constant	$g = 9.81$	m/s^2	

Drag Force Equation $$F_D = \frac{1}{2} C_D A p_w v^2$$

Bouyancy Equation $$F_B = Vg(p_w - p_B)$$

Initial Conditions		
t_o =	0	s
v_o =	3.157	mph

ELAPSED TIME (s)	**VELOCITY AT TIME (mph)**	DRAG FORCE (N)	BOUYANCY FORCE (N)	NET FORCE (N)	DISTANCE (m)	**TOTAL DEPTH (ft)**
0	**7.1**				0.0	**0.0**
0.100	1.8	149.1	33.4	-182.4	0.16	0.5
0.200	0.8	32.8	45.5	-78.3	0.22	0.7
0.300	0.3	4.9	51.0	-55.9	0.24	0.8
0.370		0.0	52.1	-52.1	0.25	0.8
0.400						
0.500						
0.570						
0.600						
0.700						
0.730						
0.800						
0.860						

Drops Vertically into the Pool

Height of COM	h = 1.20	m	
Mass of Person	m = 31.75	kg =	70 lb
Density of Water	p_w = 1000.00	kg/m^3	
Density of Person	p_B = 980.00	kg/m^3	
Cross-Sectional Area	A = 0.09	m^2 =	1 ft^2
Length of Person	L = 1.38	m =	4.54166667 ft
Volume of Person	V = 0.33	m^3	
Coefficient of Drag	C_D = 1.00		
Gravitational Constant	g = 9.81	m/s^2	

Drag Force Equation $F_D = \frac{1}{2} C_D A p_w v^2$

Bouyancy Equation $F_B = Vg(p_w - p_B)$

Initial Conditions		
t_o =	0	s
v_o =	3.157	mph

ELAPSED TIME (s)	**VELOCITY AT TIME (mph)**	DRAG FORCE (N)	BOUYANCY FORCE (N)	NET FORCE (N)	DISTANCE (m)	**TOTAL DEPTH (ft)**
0	**7.1**				0.0	**0.0**
0.100	4.7	222.4	12.1	-234.5	0.26	0.9
0.200	3.5	119.6	20.6	-140.2	0.45	1.5
0.300	2.7	70.4	27.0	-97.4	0.59	1.9
0.400	2.1	42.8	32.0	-74.8	0.69	2.3
0.500	1.6	25.8	35.8	-61.6	0.78	2.5
0.600	1.2	14.7	38.8	-53.5	0.84	2.8
0.650	1.0	10.7	40.0	-50.7	0.87	2.8
0.700	0.9	7.5	41.0	-48.5	0.89	2.9
0.800	0.5	3.0	42.5	-45.5	0.92	3.0
0.840	0.4	1.8	42.9	-44.7	0.93	3.0
0.900	0.2	0.6	43.3	-43.9	0.94	3.1
0.980		0.0	43.5	-43.5	0.94	3.1

Drops Diagonally into the Pool

Height of COM	h = 1.00	m	
Mass of Person	m = 31.75	kg =	70 lb
Density of Water	p_w = 1000.00	kg/m^3	
Density of Person	p_B = 980.00	kg/m^3	
Cross-Sectional Area	A = 0.09	m^2 =	1 ft^2
Length of Person	L = 0.98	m =	3.2114433 ft
Volume of Person	V = 0.33	m^3	
Coefficient of Drag	C_D = 1.00		
Gravitational Constant	g = 9.81	m/s^2	

Drag Force Equation $$F_D = \frac{1}{2} C_D A p_w v^2$$

Bouyancy Equation $$F_B = V g (p_w - p_B)$$

Initial Conditions		
t_o =	0	s
v_o =	3.157	mph

ELAPSED TIME (s)	**VELOCITY AT TIME (mph)**	DRAG FORCE (N)	BOUYANCY FORCE (N)	NET FORCE (N)	DISTANCE (m)	**TOTAL DEPTH (ft)**
0	**7.1**				0.0	**0.0**
0.100	4.7	221.2	17.1	-238.3	0.26	0.9
0.200	3.4	116.6	29.0	-145.6	0.44	1.5
0.300	2.6	66.0	37.9	-103.9	0.58	1.9
0.400	2.0	37.5	44.6	-82.1	0.68	2.2
0.500	1.4	20.2	49.6	-69.8	0.76	2.5
0.600	1.0	9.4	53.1	-62.6	0.81	2.7
0.650	0.7	5.8	54.4	-60.2	0.83	2.7
0.700	0.5	3.1	55.4	-58.5	0.85	2.8
0.800	0.1	0.3	56.4	-56.7	0.86	2.8
0.840		0.0	56.5	-56.5	0.87	2.8
0.900						
0.980						

Drops with Tucked Knees into the Pool

Height of COM	h = 0.85	m	
Mass of Person	m = 31.75	kg =	70 lb
Density of Water	p_w = 1000.00	kg/m^3	
Density of Person	p_B = 980.00	kg/m^3	
Cross-Sectional Area	A = 0.21	m^2 =	2.270833 ft^2
Length of Person	L = 0.69	m =	2.27083333 ft
Volume of Person	V = 0.33	m^3	
Coefficient of Drag	C_D = 1.00		
Gravitational Constant	g = 9.81	m/s^2	

Drag Force Equation $$F_D = \frac{1}{2} C_D A p_w v^2$$

Bouyancy Equation $$F_B = Vg(p_w - p_B)$$

Initial Conditions		
t_o =	0	s
v_o =	3.157	mph

ELAPSED TIME (s)	**VELOCITY AT TIME (mph)**	DRAG FORCE (N)	BOUYANCY FORCE (N)	NET FORCE (N)	DISTANCE (m)	**TOTAL DEPTH (ft)**
0	**7.1**				0.0	**0.0**
0.100	3.3	249.7	20.1	-269.8	0.22	0.7
0.200	2.0	94.0	30.9	-124.9	0.34	1.1
0.300	1.3	41.4	37.9	-79.3	0.41	1.3
0.400	0.9	17.5	42.6	-60.1	0.46	1.5
0.500	0.5	5.7	45.4	-51.1	0.49	1.6
0.600	0.1	0.6	46.8	-47.4	0.51	1.7
0.650		0.0	46.9	-46.9	0.51	1.7
0.700						
0.800						
0.840						
0.900						
0.980						

Drops Horizontally into the Pool

Height of COM	$h = 0.66$	m	
Mass of Person	$m = 31.75$	kg =	70 lb
Density of Water	$p_w = 1000.00$	kg/m^3	
Density of Person	$p_B = 980.00$	kg/m^3	
Cross-Sectional Area	$A = 0.42$	m^2 =	4.541667 ft^2
Length of Person	$L = 0.30$	m =	1 ft
Volume of Person	$V = 0.33$	m^3	
Coefficient of Drag	$C_D = 1.00$		
Gravitational Constant	$g = 9.81$	m/s^2	

Drag Force Equation $$F_D = \frac{1}{2} C_D A p_w v^2$$

Bouyancy Equation $$F_B = Vg(p_w - p_B)$$

Initial Conditions		
t_o =	0	s
v_o =	3.157	mph

ELAPSED TIME (s)	**VELOCITY AT TIME (mph)**	DRAG FORCE (N)	BOUYANCY FORCE (N)	NET FORCE (N)	DISTANCE (m)	**TOTAL DEPTH (ft)**
0	**7.1**				0.0	**0.0**
0.100	2.0	196.0	35.4	-231.4	0.17	0.6
0.200	1.0	48.8	49.3	-98.1	0.24	0.8
0.300	0.5	10.7	56.2	-67.0	0.27	0.9
0.400	0.0	0.2	58.7	-58.9	0.28	0.9
0.500						
0.600						
0.650						
0.700						
0.800						
0.840						
0.900						
0.980						

Drops Vertically into the Pool

Height of COM	$h = 1.24$	m	
Mass of Person	$m = 41.72$	kg =	92 lb
Density of Water	$p_w = 1000.00$	kg/m^3	
Density of Person	$p_B = 980.00$	kg/m^3	
Cross-Sectional Area	$A = 0.09$	m^2 =	1 ft^2
Length of Person	$L = 1.47$	m =	4.83333333 ft
Volume of Person	$V = 0.33$	m^3	
Coefficient of Drag	$C_D = 1.00$		
Gravitational Constant	$g = 9.81$	m/s^2	

Drag Force Equation $$F_D = \frac{1}{2} C_D A p_w v^2$$

Bouyancy Equation $$F_B = Vg(p_w - p_B)$$

Initial Conditions		
t_o =	0	s
v_o =	3.157	mph

ELAPSED TIME (s)	**VELOCITY AT TIME (mph)**	DRAG FORCE (N)	BOUYANCY FORCE (N)	NET FORCE (N)	DISTANCE (m)	**TOTAL DEPTH (ft)**
0	**7.1**				0.0	**0.0**
0.100	5.2	260.6	11.8	-272.4	0.27	0.9
0.200	4.0	156.0	20.8	-176.8	0.48	1.6
0.300	3.2	100.0	27.8	-127.8	0.64	2.1
0.400	2.6	66.3	33.5	-99.7	0.77	2.5
0.480	2.2	48.0	37.3	-85.2	0.86	2.8
0.500	2.1	44.2	38.1	-82.3	0.88	2.9
0.600	1.7	29.1	41.9	-71.0	0.97	3.2
0.700	1.4	18.4	44.9	-63.4	1.04	3.4
0.770	1.1	12.9	46.7	-59.6	1.08	3.5
0.800	1.1	10.9	47.3	-58.2	1.09	3.6
0.900	0.8	5.6	49.1	-54.7	1.13	3.7
1.000	0.5	2.2	50.3	-52.5	1.16	3.8
1.010	0.4	2.0	50.4	-52.4	1.16	3.8
1.100	0.2	0.4	51.0	-51.4	1.17	3.9
1.170		0.0	51.1	-51.1	1.18	3.9

Drops Diagonally into the Pool

Height of COM	h = 1.03	m	
Mass of Person	m = 41.72	kg =	92 lb
Density of Water	p_w = 1000.00	kg/m^3	
Density of Person	p_B = 980.00	kg/m^3	
Cross-Sectional Area	A = 0.09	m^2 =	1 ft^2
Length of Person	L = 1.04	m =	3.41768278 ft
Volume of Person	V = 0.33	m^3	
Coefficient of Drag	C_D = 1.00		
Gravitational Constant	g = 9.81	m/s^2	

Drag Force Equation $$F_D = \frac{1}{2} C_D A p_w v^2$$

Bouyancy Equation $$F_B = Vg(p_w - p_B)$$

Initial Conditions		
t_o =	0	s
v_o =	3.157	mph

ELAPSED TIME (s)	**VELOCITY AT TIME (mph)**	DRAG FORCE (N)	BOUYANCY FORCE (N)	NET FORCE (N)	DISTANCE (m)	**TOTAL DEPTH (ft)**
0	**7.1**				0.0	**0.0**
0.100	5.1	259.5	16.7	-276.3	0.27	0.9
0.200	4.0	153.2	29.3	-182.5	0.48	1.6
0.300	3.1	95.8	39.1	-134.9	0.64	2.1
0.400	2.5	60.9	46.9	-107.7	0.76	2.5
0.480	2.1	42.0	51.9	-93.9	0.85	2.8
0.500	2.0	38.1	53.1	-91.2	0.87	2.8
0.600	1.5	22.7	57.9	-80.6	0.94	3.1
0.700	1.1	12.3	61.6	-73.9	1.00	3.3
0.770	0.8	7.2	63.5	-70.6	1.03	3.4
0.800	0.7	5.4	64.1	-69.6	1.05	3.4
0.900	0.4	1.5	65.7	-67.2	1.07	3.5
1.000	0.0	0.0	66.2	-66.2	1.08	3.5
1.010		0.0	66.2	-66.2	1.08	3.5
1.100						
1.170						

Drops with Tucked Knees into the Pool

Height of COM	$h = 0.88$	m	
Mass of Person	$m = 41.72$	kg =	92 lb
Density of Water	$p_w = 1000.00$	kg/m^3	
Density of Person	$p_B = 980.00$	kg/m^3	
Cross-Sectional Area	$A = 0.22$	m^2 =	2.416667 ft^2
Length of Person	$L = 0.74$	m =	2.41666667 ft
Volume of Person	$V = 0.33$	m^3	
Coefficient of Drag	$C_D = 1.00$		
Gravitational Constant	$g = 9.81$	m/s^2	

Drag Force Equation $$F_D = \frac{1}{2} C_D A p_w v^2$$

Bouyancy Equation $$F_B = Vg(p_w - p_B)$$

Initial Conditions		
$t_o =$	0	s
$v_o =$	3.157	mph

ELAPSED TIME (s)	**VELOCITY AT TIME (mph)**	DRAG FORCE (N)	BOUYANCY FORCE (N)	NET FORCE (N)	DISTANCE (m)	**TOTAL DEPTH (ft)**
0	**7.1**				0.0	**0.0**
0.100	3.7	331.9	20.0	-351.9	0.23	0.8
0.200	2.4	139.3	31.8	-171.1	0.37	1.2
0.300	1.7	68.7	39.7	-108.4	0.46	1.5
0.400	1.2	34.8	45.4	-80.2	0.52	1.7
0.480	0.9	19.3	48.7	-68.0	0.56	1.8
0.500	0.8	16.4	49.4	-65.7	0.57	1.9
0.600	0.5	6.1	52.0	-58.1	0.60	2.0
0.700	0.2	1.1	53.3	-54.4	0.61	2.0
0.770		0.0	53.6	-53.6	0.62	2.0
0.800						
0.900						
1.000						
1.010						
1.100						
1.170						

Drops Horizontally into the Pool

Height of COM	$h = 0.66$	m	
Mass of Person	$m = 41.72$	kg =	92 lb
Density of Water	$p_w = 1000.00$	kg/m^3	
Density of Person	$p_B = 980.00$	kg/m^3	
Cross-Sectional Area	$A = 0.45$	m^2 =	4.833333 ft^2
Length of Person	$L = 0.30$	m =	1 ft
Volume of Person	$V = 0.33$	m^3	
Coefficient of Drag	$C_D = 1.00$		
Gravitational Constant	$g = 9.81$	m/s^2	

Drag Force Equation $$F_D = \frac{1}{2} C_D A p_w v^2$$

Bouyancy Equation $$F_B = Vg(p_w - p_B)$$

Initial Conditions		
$t_o =$	0	s
$v_o =$	3.157	mph

ELAPSED TIME (s)	**VELOCITY AT TIME (mph)**	DRAG FORCE (N)	BOUYANCY FORCE (N)	NET FORCE (N)	DISTANCE (m)	**TOTAL DEPTH (ft)**
0	**7.1**				0.0	**0.0**
0.100	2.4	287.9	38.7	-326.6	0.18	0.6
0.200	1.3	83.4	55.6	-139.0	0.27	0.9
0.300	0.7	25.8	65.0	-90.8	0.31	1.0
0.400	0.3	4.5	69.8	-74.4	0.33	1.1
0.480		0.0	70.9	-70.9	0.34	1.1
0.500						
0.600						
0.700						
0.770						
0.800						
0.900						
1.000						
1.010						
1.100						
1.170						

12-year-old Boy Calculations

Drops Vertically into the Pool

Height of COM	h = 1.21	m	
Mass of Person	m = 32.20	kg =	71 lb
Density of Water	p_w = 1000.00	kg/m^3	
Density of Person	p_B = 980.00	kg/m^3	
Cross-Sectional Area	A = 0.09	m^2 =	1 ft^2
Length of Person	L = 1.40	m =	4.58333333 ft
Volume of Person	V = 0.33	m^3	
Coefficient of Drag	C_D = 1.00		
Gravitational Constant	g = 9.81	m/s^2	

Drag Force Equation $$F_D = \frac{1}{2} C_D A p_w v^2$$

Bouyancy Equation $$F_B = Vg(p_w - p_B)$$

Initial Conditions		
t_o =	0	s
v_o =	3.157	mph

ELAPSED TIME (s)	**VELOCITY AT TIME (mph)**	DRAG FORCE (N)	BOUYANCY FORCE (N)	NET FORCE (N)	DISTANCE (m)	**TOTAL DEPTH (ft)**
0	**7.1**				0.0	**0.0**
0.100	4.8	224.5	12.0	-236.5	0.26	0.9
0.200	3.5	121.5	20.5	-142.0	0.45	1.5
0.300	2.7	71.9	26.9	-98.8	0.59	1.9
0.400	2.1	43.9	31.9	-75.8	0.70	2.3
0.410	2.1	41.8	32.3	-74.2	0.71	2.3
0.500	1.7	26.7	35.8	-62.4	0.78	2.6
0.600	1.3	15.4	38.8	-54.2	0.85	2.8
0.650	1.1	11.3	40.0	-51.3	0.87	2.9
0.700	0.9	8.0	41.0	-49.0	0.90	2.9
0.800	0.6	3.3	42.5	-45.9	0.93	3.1
0.850	0.4	1.8	43.0	-44.9	0.94	3.1
0.900	0.3	0.8	43.4	-44.2	0.95	3.1
0.990		0.0	43.6	-43.7	0.95	3.1
1.000						

Drops Diagonally into the Pool

Height of COM	h = 1.00	m	
Mass of Person	m = 32.20	kg =	71 lb
Density of Water	p_w = 1000.00	kg/m^3	
Density of Person	p_B = 980.00	kg/m^3	
Cross-Sectional Area	A = 0.09	m^2 =	1 ft^2
Length of Person	L = 0.99	m =	3.24090608 ft
Volume of Person	V = 0.33	m^3	
Coefficient of Drag	C_D = 1.00		
Gravitational Constant	g = 9.81	m/s^2	

Drag Force Equation $$F_D = \frac{1}{2} C_D A p_w v^2$$

Bouyancy Equation $$F_B = V g (p_w - p_B)$$

Initial Conditions		
t_o =	0	s
v_o =	3.157	mph

ELAPSED TIME (s)	**VELOCITY AT TIME (mph)**	DRAG FORCE (N)	BOUYANCY FORCE (N)	NET FORCE (N)	DISTANCE (m)	**TOTAL DEPTH (ft)**
0	**7.1**				0.0	**0.0**
0.100	4.7	223.2	17.0	-240.2	0.26	0.9
0.200	3.5	118.4	28.9	-147.3	0.45	1.5
0.300	2.6	67.5	37.8	-105.3	0.58	1.9
0.400	2.0	38.7	44.5	-83.2	0.69	2.3
0.410	1.9	36.5	45.0	-81.6	0.70	2.3
0.500	1.5	21.1	49.5	-70.6	0.77	2.5
0.600	1.0	10.1	53.1	-63.2	0.82	2.7
0.650	0.8	6.3	54.4	-60.8	0.84	2.8
0.700	0.6	3.5	55.4	-59.0	0.86	2.8
0.800	0.2	0.4	56.6	-57.0	0.87	2.9
0.850		0.0	56.7	-56.7	0.88	2.9
0.900						
0.990						
1.000						

Drops with Tucked Knees into the Pool

Height of COM	h = 0.86	m	
Mass of Person	m = 32.20	kg =	71 lb
Density of Water	p_w = 1000.00	kg/m^3	
Density of Person	p_B = 980.00	kg/m^3	
Cross-Sectional Area	A = 0.21	m^2 =	2.291667 ft^2
Length of Person	L = 0.70	m =	2.29166667 ft
Volume of Person	V = 0.33	m^3	
Coefficient of Drag	C_D = 1.00		
Gravitational Constant	g = 9.81	m/s^2	

Drag Force Equation $F_D = \frac{1}{2} C_D A p_w v^2$

Bouyancy Equation $F_B = V g (p_w - p_B)$

Initial Conditions		
t_o =	0	s
v_o =	3.157	mph

ELAPSED TIME (s)	**VELOCITY AT TIME (mph)**	DRAG FORCE (N)	BOUYANCY FORCE (N)	NET FORCE (N)	DISTANCE (m)	**TOTAL DEPTH (ft)**
0	**7.1**				0.0	**0.0**
0.100	3.3	253.6	20.0	-273.5	0.22	0.7
0.200	2.0	95.8	30.7	-126.6	0.34	1.1
0.300	1.4	42.5	37.7	-80.2	0.41	1.4
0.400	0.9	18.2	42.3	-60.6	0.46	1.5
0.410	0.8	16.6	42.7	-59.3	0.47	1.5
0.500	0.5	6.2	45.2	-51.4	0.49	1.6
0.600	0.2	0.8	46.7	-47.5	0.51	1.7
0.650		0.0	46.9	-46.9	0.51	1.7
0.700						
0.800						
0.850						
0.900						
0.990						
1.000						

Drops Horizontally into the Pool

Height of COM	h = 0.66	m	
Mass of Person	m = 32.20	kg =	71 lb
Density of Water	p_w = 1000.00	kg/m^3	
Density of Person	p_B = 980.00	kg/m^3	
Cross-Sectional Area	A = 0.43	m^2 =	4.583333 ft^2
Length of Person	L = 0.30	m =	1 ft
Volume of Person	V = 0.33	m^3	
Coefficient of Drag	C_D = 1.00		
Gravitational Constant	g = 9.81	m/s^2	

Drag Force Equation $F_D = \frac{1}{2} C_D A p_w v^2$

Bouyancy Equation $F_B = V g (p_w - p_B)$

Initial Conditions		
t_o =	0	s
v_o =	3.157	mph

ELAPSED TIME (s)	**VELOCITY AT TIME (mph)**	DRAG FORCE (N)	BOUYANCY FORCE (N)	NET FORCE (N)	DISTANCE (m)	**TOTAL DEPTH (ft)**
0	**7.1**				0.0	**0.0**
0.100	2.0	199.5	35.5	-235.0	0.17	0.6
0.200	1.0	50.0	49.5	-99.4	0.24	0.8
0.300	0.5	11.2	56.5	-67.7	0.27	0.9
0.400	0.0	0.3	59.0	-59.3	0.28	0.9
0.410		0.1	59.0	-59.1	0.28	0.9
0.500						
0.600						
0.650						
0.700						
0.800						
0.850						
0.900						
0.990						
1.000						

Drops Vertically into the Pool

Height of COM	h = 1.25	m	
Mass of Person	m = 40.36	kg =	89 lb
Density of Water	p_w = 1000.00	kg/m^3	
Density of Person	p_B = 980.00	kg/m^3	
Cross-Sectional Area	A = 0.09	m^2 =	1 ft^2
Length of Person	L = 1.49	m =	4.89583333 ft
Volume of Person	V = 0.33	m^3	
Coefficient of Drag	C_D = 1.00		
Gravitational Constant	g = 9.81	m/s^2	

Drag Force Equation $$F_D = \frac{1}{2} C_D A p_w v^2$$

Bouyancy Equation $$F_B = Vg(p_w - p_B)$$

Initial Conditions		
t_o =	0	s
v_o =	3.157	mph

ELAPSED TIME (s)	**VELOCITY AT TIME (mph)**	DRAG FORCE (N)	BOUYANCY FORCE (N)	NET FORCE (N)	DISTANCE (m)	**TOTAL DEPTH (ft)**
0	**7.1**				0.0	**0.0**
0.100	5.1	256.1	11.6	-267.8	0.27	0.9
0.200	3.9	151.6	20.3	-171.9	0.47	1.6
0.300	3.2	96.4	27.2	-123.5	0.63	2.1
0.400	2.6	63.4	32.7	-96.0	0.76	2.5
0.470	2.2	47.5	35.9	-83.4	0.84	2.8
0.500	2.1	42.0	37.1	-79.1	0.87	2.8
0.600	1.7	27.4	40.8	-68.1	0.95	3.1
0.700	1.3	17.1	43.7	-60.8	1.02	3.3
0.760	1.1	12.5	45.1	-57.6	1.05	3.5
0.800	1.0	9.9	45.9	-55.9	1.07	3.5
0.900	0.7	5.0	47.6	-52.6	1.11	3.6
0.990	0.4	2.1	48.6	-50.7	1.14	3.7
1.000	0.4	1.9	48.7	-50.6	1.14	3.7
1.100	0.1	0.3	49.3	-49.5	1.15	3.8
1.160		0.0	49.3	-49.3	1.15	3.8

Drops Diagonally into the Pool

Height of COM	h = 1.04	m	
Mass of Person	m = 40.36	kg =	89 lb
Density of Water	p_w = 1000.00	kg/m^3	
Density of Person	p_B = 980.00	kg/m^3	
Cross-Sectional Area	A = 0.09	m^2 =	1 ft^2
Length of Person	L = 1.06	m =	3.46187695 ft
Volume of Person	V = 0.33	m^3	
Coefficient of Drag	C_D = 1.00		
Gravitational Constant	g = 9.81	m/s^2	

Drag Force Equation $$F_D = \frac{1}{2} C_D A p_w v^2$$

Bouyancy Equation $$F_B = V g (p_w - p_B)$$

Initial Conditions		
t_o =	0	s
v_o =	3.157	mph

ELAPSED TIME (s)	**VELOCITY AT TIME (mph)**	DRAG FORCE (N)	BOUYANCY FORCE (N)	NET FORCE (N)	DISTANCE (m)	**TOTAL DEPTH (ft)**
0	**7.1**				0.0	**0.0**
0.100	5.1	255.1	16.5	-271.5	0.27	0.9
0.200	3.9	148.8	28.7	-177.5	0.47	1.6
0.300	3.1	92.2	38.2	-130.4	0.63	2.1
0.400	2.4	58.1	45.7	-103.8	0.76	2.5
0.470	2.1	41.7	50.0	-91.8	0.83	2.7
0.500	1.9	36.0	51.7	-87.7	0.85	2.8
0.600	1.5	21.2	56.3	-77.5	0.93	3.1
0.700	1.1	11.2	59.8	-71.0	0.99	3.2
0.760	0.8	7.0	61.3	-68.3	1.01	3.3
0.800	0.7	4.8	62.2	-66.9	1.03	3.4
0.900	0.3	1.2	63.6	-64.7	1.05	3.4
0.990		0.0	64.0	-64.0	1.06	3.5
1.000						
1.100						
1.160						

Drops with Tucked Knees into the Pool

Height of COM	h = 0.88	m	
Mass of Person	m = 40.36	kg =	89 lb
Density of Water	p_w = 1000.00	kg/m^3	
Density of Person	p_B = 980.00	kg/m^3	
Cross-Sectional Area	A = 0.23	m^2 =	2.447917 ft^2
Length of Person	L = 0.75	m =	2.44791667 ft
Volume of Person	V = 0.33	m^3	
Coefficient of Drag	C_D = 1.00		
Gravitational Constant	g = 9.81	m/s^2	

Drag Force Equation $$F_D = \frac{1}{2} C_D A p_w v^2$$

Bouyancy Equation $$F_B = Vg(p_w - p_B)$$

Initial Conditions		
t_o =	0	s
v_o =	3.157	mph

ELAPSED TIME (s)	**VELOCITY AT TIME (mph)**	DRAG FORCE (N)	BOUYANCY FORCE (N)	NET FORCE (N)	DISTANCE (m)	**TOTAL DEPTH (ft)**
0	**7.1**				0.0	**0.0**
0.100	3.6	321.4	19.6	-341.0	0.23	0.7
0.200	2.3	132.5	30.8	-163.3	0.36	1.2
0.300	1.6	64.5	38.4	-102.9	0.45	1.5
0.400	1.1	32.2	43.8	-76.0	0.51	1.7
0.470	0.9	19.0	46.5	-65.5	0.54	1.8
0.500	0.8	14.8	47.5	-62.3	0.55	1.8
0.600	0.5	5.3	49.9	-55.2	0.58	1.9
0.700	0.2	0.8	51.1	-51.9	0.60	2.0
0.760		0.0	51.3	-51.3	0.60	2.0
0.800						
0.900						
0.990						
1.000						
1.100						
1.160						

Drops Horizontally into the Pool

Height of COM	h = 0.66	m	
Mass of Person	m = 40.36	kg =	89 lb
Density of Water	p_w = 1000.00	kg/m^3	
Density of Person	p_B = 980.00	kg/m^3	
Cross-Sectional Area	A = 0.45	m^2 =	4.895833 ft^2
Length of Person	L = 0.30	m =	1 ft
Volume of Person	V = 0.33	m^3	
Coefficient of Drag	C_D = 1.00		
Gravitational Constant	g = 9.81	m/s^2	

Drag Force Equation $$F_D = \frac{1}{2} C_D A p_w v^2$$

Bouyancy Equation $$F_B = Vg(p_w - p_B)$$

Initial Conditions		
t_o =	0	s
v_o =	3.157	mph

ELAPSED TIME (s)	**VELOCITY AT TIME (mph)**	DRAG FORCE (N)	BOUYANCY FORCE (N)	NET FORCE (N)	DISTANCE (m)	**TOTAL DEPTH (ft)**
0	**7.1**				0.0	**0.0**
0.100	2.3	273.1	38.0	-311.0	0.18	0.6
0.200	1.2	77.3	54.3	-131.5	0.26	0.8
0.300	0.7	23.0	63.2	-86.2	0.30	1.0
0.400	0.2	3.5	67.6	-71.1	0.32	1.1
0.470		0.0	68.4	-68.4	0.33	1.1
0.500						
0.600						
0.700						
0.760						
0.800						
0.900						
0.990						
1.000						
1.100						
1.160						

Drops Vertically into the Pool

Height of COM	h = 1.30	m	
Mass of Person	m = 53.51	kg =	118 lb
Density of Water	p_w = 1000.00	kg/m^3	
Density of Person	p_B = 980.00	kg/m^3	
Cross-Sectional Area	A = 0.09	m^2 =	1 ft^2
Length of Person	L = 1.59	m =	5.22916667 ft
Volume of Person	V = 0.33	m^3	
Coefficient of Drag	C_D = 1.00		
Gravitational Constant	g = 9.81	m/s^2	

Drag Force Equation $$F_D = \frac{1}{2} C_D A p_w v^2$$

Bouyancy Equation $$F_B = Vg(p_w - p_B)$$

Initial Conditions		
t_o =	0	s
v_o =	3.157	mph

ELAPSED TIME (s)	**VELOCITY AT TIME (mph)**	DRAG FORCE (N)	BOUYANCY FORCE (N)	NET FORCE (N)	DISTANCE (m)	**TOTAL DEPTH (ft)**
0	**7.1**				0.0	**0.0**
0.100	5.5	292.9	11.3	-304.2	0.28	0.9
0.200	4.5	191.3	20.2	-211.5	0.50	1.7
0.300	3.7	131.5	27.6	-159.0	0.69	2.3
0.400	3.1	93.0	33.7	-126.7	0.84	2.8
0.500	2.6	66.6	38.9	-105.4	0.97	3.2
0.540	2.5	58.3	40.7	-99.0	1.02	3.3
0.600	2.2	47.7	43.3	-90.9	1.08	3.5
0.700	1.9	33.7	47.0	-80.7	1.17	3.8
0.800	1.6	23.3	50.0	-73.3	1.25	4.1
0.900	1.3	15.4	52.6	-68.0	1.31	4.3
0.910	1.2	14.7	52.8	-67.5	1.32	4.3
1.000	1.0	9.5	54.6	-64.1	1.36	4.5
1.100	0.7	5.2	56.2	-61.4	1.40	4.6
1.200	0.5	2.3	57.3	-59.6	1.43	4.7
1.300	0.2	0.6	57.9	-58.5	1.44	4.7
1.400		0.0	58.1	-58.1	1.45	4.8

Drops Diagonally into the Pool

Height of COM	h = 1.07	m	
Mass of Person	m = 53.51	kg =	118 lb
Density of Water	p_w = 1000.00	kg/m^3	
Density of Person	p_B = 980.00	kg/m^3	
Cross-Sectional Area	A = 0.09	m^2 =	1 ft^2
Length of Person	L = 1.13	m =	3.69757921 ft
Volume of Person	V = 0.33	m^3	
Coefficient of Drag	C_D = 1.00		
Gravitational Constant	g = 9.81	m/s^2	

Drag Force Equation $$F_D = \frac{1}{2} C_D A p_w v^2$$

Bouyancy Equation $$F_B = Vg(p_w - p_B)$$

Initial Conditions		
t_o =	0	s
v_o =	3.157	mph

ELAPSED TIME (s)	**VELOCITY AT TIME (mph)**	DRAG FORCE (N)	BOUYANCY FORCE (N)	NET FORCE (N)	DISTANCE (m)	**TOTAL DEPTH (ft)**
0	**7.1**				0.0	**0.0**
0.100	5.5	292.0	15.9	-308.0	0.28	0.9
0.200	4.4	188.9	28.5	-217.5	0.50	1.7
0.300	3.6	127.6	38.8	-166.4	0.68	2.2
0.400	3.0	87.8	47.3	-135.1	0.83	2.7
0.500	2.5	60.5	54.3	-114.8	0.96	3.1
0.540	2.3	51.9	56.8	-108.7	1.00	3.3
0.600	2.1	40.9	60.2	-101.1	1.06	3.5
0.700	1.7	26.7	64.9	-91.6	1.15	3.8
0.800	1.3	16.3	68.7	-85.0	1.21	4.0
0.900	0.9	8.9	71.6	-80.5	1.26	4.1
0.910	0.9	8.3	71.8	-80.1	1.27	4.2
1.000	0.6	3.9	73.6	-77.5	1.30	4.3
1.100	0.3	1.0	74.8	-75.8	1.32	4.3
1.200		0.0	75.2	-75.2	1.33	4.4
1.300						
1.400						

Drops with Tucked Knees into the Pool

Height of COM	$h = 0.91$	m	
Mass of Person	$m = 53.51$	kg =	118 lb
Density of Water	$p_w = 1000.00$	kg/m^3	
Density of Person	$p_B = 980.00$	kg/m^3	
Cross-Sectional Area	$A = 0.24$	$m^2 =$	2.614583 ft^2
Length of Person	$L = 0.80$	m =	2.61458333 ft
Volume of Person	$V = 0.33$	m^3	
Coefficient of Drag	$C_D = 1.00$		
Gravitational Constant	$g = 9.81$	m/s^2	

Drag Force Equation $$F_D = \frac{1}{2} C_D A p_w v^2$$

Bouyancy Equation $$F_B = Vg(p_w - p_B)$$

Initial Conditions		
$t_o =$	0	s
$v_o =$	3.157	mph

ELAPSED TIME (s)	**VELOCITY AT TIME (mph)**	DRAG FORCE (N)	BOUYANCY FORCE (N)	NET FORCE (N)	DISTANCE (m)	**TOTAL DEPTH (ft)**
0	**7.1**				0.0	**0.0**
0.100	4.0	420.9	19.3	-440.2	0.24	0.8
0.200	2.7	192.3	31.3	-223.6	0.39	1.3
0.300	2.0	102.6	39.8	-142.4	0.50	1.6
0.400	1.5	57.7	46.1	-103.8	0.58	1.9
0.500	1.1	32.2	50.8	-83.0	0.63	2.1
0.540	1.0	25.1	52.4	-77.4	0.65	2.1
0.600	0.8	16.7	54.3	-71.0	0.68	2.2
0.700	0.5	7.3	56.7	-64.0	0.71	2.3
0.800	0.3	2.0	58.2	-60.2	0.73	2.4
0.900	0.0	0.0	58.7	-58.7	0.73	2.4
0.910		0.0	58.7	-58.7	0.73	2.4
1.000						
1.100						
1.200						
1.300						
1.400						

Drops Horizontally into the Pool

Height of COM	h = 0.66	m	
Mass of Person	m = 53.51	kg =	118 lb
Density of Water	p_w = 1000.00	kg/m^3	
Density of Person	p_B = 980.00	kg/m^3	
Cross-Sectional Area	A = 0.49	m^2 =	5.229167 ft^2
Length of Person	L = 0.30	m =	1 ft
Volume of Person	V = 0.33	m^3	
Coefficient of Drag	C_D = 1.00		
Gravitational Constant	g = 9.81	m/s^2	

Drag Force Equation $$F_D = \frac{1}{2} C_D A p_w v^2$$

Bouyancy Equation $$F_B = Vg(p_w - p_B)$$

Initial Conditions		
t_o =	0	s
v_o =	3.157	mph

ELAPSED TIME (s)	**VELOCITY AT TIME (mph)**	DRAG FORCE (N)	BOUYANCY FORCE (N)	NET FORCE (N)	DISTANCE (m)	**TOTAL DEPTH (ft)**
0	**7.1**				0.0	**0.0**
0.100	2.7	394.8	41.3	-436.1	0.20	0.6
0.200	1.5	127.5	60.8	-188.4	0.29	1.0
0.300	0.9	47.3	72.5	-119.8	0.35	1.1
0.400	0.5	14.3	79.4	-93.7	0.38	1.2
0.500	0.1	1.5	82.5	-84.0	0.39	1.3
0.540		0.1	82.9	-82.9	0.40	1.3
0.600						
0.700						
0.800						
0.900						
0.910						
1.000						
1.100						
1.200						
1.300						
1.400						

14-year-old Boy Calculations

Drops Vertically into the Pool

Height of COM	h = 1.28	m	
Mass of Person	m = 40.36	kg =	89 lb
Density of Water	p_w = 1000.00	kg/m^3	
Density of Person	p_B = 980.00	kg/m^3	
Cross-Sectional Area	A = 0.09	m^2 =	1 ft^2
Length of Person	L = 1.54	m =	5.04166667 ft
Volume of Person	V = 0.33	m^3	
Coefficient of Drag	C_D = 1.00		
Gravitational Constant	g = 9.81	m/s^2	

Drag Force Equation $$F_D = \frac{1}{2} C_D A p_w v^2$$

Bouyancy Equation $$F_B = Vg(p_w - p_B)$$

Initial Conditions		
t_o =	0	s
v_o =	3.157	mph

ELAPSED TIME (s)	**VELOCITY AT TIME (mph)**	DRAG FORCE (N)	BOUYANCY FORCE (N)	NET FORCE (N)	DISTANCE (m)	**TOTAL DEPTH (ft)**
0	**7.1**				0.0	**0.0**
0.100	5.1	256.2	11.3	-267.5	0.27	0.9
0.200	3.9	151.8	19.7	-171.5	0.48	1.6
0.300	3.2	96.7	26.4	-123.1	0.63	2.1
0.400	2.6	63.7	31.7	-95.5	0.76	2.5
0.470	2.2	47.9	34.9	-82.8	0.84	2.8
0.500	2.1	42.4	36.1	-78.5	0.87	2.8
0.600	1.7	27.8	39.7	-67.5	0.95	3.1
0.700	1.3	17.6	42.5	-60.1	1.02	3.4
0.770	1.1	12.3	44.1	-56.4	1.06	3.5
0.800	1.0	10.4	44.7	-55.1	1.08	3.5
0.900	0.7	5.4	46.4	-51.8	1.12	3.7
1.000	0.5	2.1	47.5	-49.7	1.14	3.7
1.010	0.4	1.9	47.6	-49.5	1.14	3.8
1.100	0.2	0.4	48.1	-48.5	1.16	3.8
1.110	0.2	0.3	48.2	-48.5	1.16	3.8
1.170		0.0	48.3	-48.3	1.16	3.8

Drops Diagonally into the Pool

Height of COM	h = 1.05	m	
Mass of Person	m = 40.36	kg =	89 lb
Density of Water	p_w = 1000.00	kg/m^3	
Density of Person	p_B = 980.00	kg/m^3	
Cross-Sectional Area	A = 0.09	m^2 =	1 ft^2
Length of Person	L = 1.09	m =	3.56499669 ft
Volume of Person	V = 0.33	m^3	
Coefficient of Drag	C_D = 1.00		
Gravitational Constant	g = 9.81	m/s^2	

Drag Force Equation $F_D = \frac{1}{2} C_D A p_w v^2$

Bouyancy Equation $F_B = Vg(p_w - p_B)$

Initial Conditions		
t_o =	0	s
v_o =	3.157	mph

ELAPSED TIME (s)	**VELOCITY AT TIME (mph)**	DRAG FORCE (N)	BOUYANCY FORCE (N)	NET FORCE (N)	DISTANCE (m)	**TOTAL DEPTH (ft)**
0	**7.1**				0.0	**0.0**
0.100	5.1	255.2	16.0	-271.2	0.27	0.9
0.200	3.9	149.1	27.9	-177.0	0.47	1.6
0.300	3.1	92.6	37.1	-129.7	0.63	2.1
0.400	2.5	58.6	44.4	-103.0	0.76	2.5
0.470	2.1	42.3	48.7	-90.9	0.83	2.7
0.500	1.9	36.6	50.3	-86.8	0.85	2.8
0.600	1.5	21.8	54.8	-76.6	0.93	3.1
0.700	1.1	11.7	58.2	-70.0	0.99	3.2
0.770	0.8	6.8	60.0	-66.9	1.02	3.3
0.800	0.7	5.2	60.6	-65.8	1.03	3.4
0.900	0.4	1.4	62.1	-63.5	1.06	3.5
1.000	0.0	0.0	62.6	-62.6	1.06	3.5
1.010		0.0	62.6	-62.6	1.06	3.5
1.100						
1.110						
1.170						

Drops with Tucked Knees into the Pool

Height of COM	h = 0.89	m	
Mass of Person	m = 40.36	kg =	89 lb
Density of Water	p_w = 1000.00	kg/m^3	
Density of Person	p_B = 980.00	kg/m^3	
Cross-Sectional Area	A = 0.23	m^2 =	2.520833 ft^2
Length of Person	L = 0.77	m =	2.52083333 ft
Volume of Person	V = 0.33	m^3	
Coefficient of Drag	C_D = 1.00		
Gravitational Constant	g = 9.81	m/s^2	

Drag Force Equation $$F_D = \frac{1}{2} C_D A p_w v^2$$

Bouyancy Equation $$F_B = V g (p_w - p_B)$$

Initial Conditions		
t_o =	0	s
v_o =	3.157	mph

ELAPSED TIME (s)	**VELOCITY AT TIME (mph)**	DRAG FORCE (N)	BOUYANCY FORCE (N)	NET FORCE (N)	DISTANCE (m)	**TOTAL DEPTH (ft)**
0	**7.1**				0.0	**0.0**
0.100	3.5	321.8	18.8	-340.6	0.23	0.7
0.200	2.3	131.5	29.6	-161.1	0.36	1.2
0.300	1.6	63.9	36.8	-100.7	0.44	1.5
0.400	1.1	32.0	41.9	-74.0	0.50	1.7
0.470	0.9	19.0	44.6	-63.6	0.54	1.8
0.500	0.8	14.9	45.5	-60.4	0.55	1.8
0.600	0.5	5.5	47.8	-53.3	0.57	1.9
0.700	0.2	0.9	49.0	-49.9	0.59	1.9
0.770		0.0	49.2	-49.2	0.59	1.9
0.800						
0.900						
1.000						
1.010						
1.100						
1.110						
1.170						

Drops Horizontally into the Pool

Height of COM	h = 0.66	m	
Mass of Person	m = 40.36	kg =	89 lb
Density of Water	p_w = 1000.00	kg/m^3	
Density of Person	p_B = 980.00	kg/m^3	
Cross-Sectional Area	A = 0.47	m^2 =	5.041667 ft^2
Length of Person	L = 0.30	m =	1 ft
Volume of Person	V = 0.33	m^3	
Coefficient of Drag	C_D = 1.00		
Gravitational Constant	g = 9.81	m/s^2	

Drag Force Equation $$F_D = \frac{1}{2} C_D A p_w v^2$$

Bouyancy Equation $$F_B = Vg(p_w - p_B)$$

Initial Conditions		
t_o =	0	s
v_o =	3.157	mph

ELAPSED TIME (s)	**VELOCITY AT TIME (mph)**	DRAG FORCE (N)	BOUYANCY FORCE (N)	NET FORCE (N)	DISTANCE (m)	**TOTAL DEPTH (ft)**
0	**7.1**				0.0	**0.0**
0.100	2.2	269.8	37.5	-307.3	0.18	0.6
0.200	1.2	75.6	53.4	-129.1	0.25	0.8
0.300	0.6	22.3	62.2	-84.4	0.30	1.0
0.400	0.2	3.3	66.4	-69.7	0.32	1.0
0.470		0.0	67.1	-67.1	0.32	1.1
0.500						
0.600						
0.700						
0.770						
0.800						
0.900						
1.000						
1.010						
1.100						
1.110						
1.170						

Drops Vertically into the Pool

Height of COM	h = 1.33	m	
Mass of Person	m = 50.79	kg =	112 lb
Density of Water	p_w = 1000.00	kg/m^3	
Density of Person	p_B = 980.00	kg/m^3	
Cross-Sectional Area	A = 0.09	m^2 =	1 ft^2
Length of Person	L = 1.64	m =	5.375 ft
Volume of Person	V = 0.33	m^3	
Coefficient of Drag	C_D = 1.00		
Gravitational Constant	g = 9.81	m/s^2	

Drag Force Equation $$F_D = \frac{1}{2} C_D A p_w v^2$$

Bouyancy Equation $$F_B = Vg(p_w - p_B)$$

Initial Conditions		
t_o =	0	s
v_o =	3.157	mph

ELAPSED TIME (s)	**VELOCITY AT TIME (mph)**	DRAG FORCE (N)	BOUYANCY FORCE (N)	NET FORCE (N)	DISTANCE (m)	**TOTAL DEPTH (ft)**
0	**7.1**				0.0	**0.0**
0.100	5.4	286.4	10.9	-297.4	0.28	0.9
0.200	4.4	184.1	19.5	-203.6	0.50	1.6
0.300	3.6	125.0	26.5	-151.5	0.68	2.2
0.400	3.0	87.5	32.3	-119.8	0.83	2.7
0.500	2.5	62.1	37.1	-99.3	0.95	3.1
0.530	2.4	56.1	38.4	-94.5	0.99	3.2
0.600	2.1	44.1	41.2	-85.3	1.06	3.5
0.700	1.8	30.9	44.7	-75.6	1.15	3.8
0.800	1.5	21.0	47.6	-68.6	1.22	4.0
0.890	1.2	14.3	49.7	-64.0	1.27	4.2
0.900	1.2	13.7	49.9	-63.6	1.28	4.2
1.000	0.9	8.2	51.8	-60.0	1.33	4.4
1.100	0.7	4.3	53.2	-57.5	1.36	4.5
1.180	0.5	2.2	54.0	-56.1	1.38	4.5
1.200	0.4	1.7	54.1	-55.8	1.39	4.6
1.300	0.2	0.3	54.6	-55.0	1.40	4.6
1.370		0.0	54.7	-54.7	1.40	4.6

Drops Diagonally into the Pool

Height of COM	h = 1.09	m	
Mass of Person	m = 50.79	kg =	112 lb
Density of Water	p_w = 1000.00	kg/m^3	
Density of Person	p_B = 980.00	kg/m^3	
Cross-Sectional Area	A = 0.09	m^2 =	1 ft^2
Length of Person	L = 1.16	m =	3.80069895 ft
Volume of Person	V = 0.33	m^3	
Coefficient of Drag	C_D = 1.00		
Gravitational Constant	g = 9.81	m/s^2	

Drag Force Equation $$F_D = \frac{1}{2} C_D A p_w v^2$$

Bouyancy Equation $$F_B = Vg(p_w - p_B)$$

Initial Conditions		
t_o =	0	s
v_o =	3.157	mph

ELAPSED TIME (s)	**VELOCITY AT TIME (mph)**	DRAG FORCE (N)	BOUYANCY FORCE (N)	NET FORCE (N)	DISTANCE (m)	**TOTAL DEPTH (ft)**
0	**7.1**				0.0	**0.0**
0.100	5.4	285.6	15.4	-301.0	0.28	0.9
0.200	4.3	181.7	27.5	-209.2	0.50	1.6
0.300	3.5	121.2	37.3	-158.5	0.68	2.2
0.400	2.9	82.5	45.3	-127.8	0.82	2.7
0.500	2.4	56.2	51.9	-108.1	0.94	3.1
0.530	2.3	50.0	53.7	-103.6	0.97	3.2
0.600	2.0	37.6	57.4	-95.0	1.04	3.4
0.700	1.6	24.2	61.8	-85.9	1.12	3.7
0.800	1.2	14.5	65.2	-79.7	1.18	3.9
0.890	0.9	8.2	67.6	-75.8	1.23	4.0
0.900	0.9	7.6	67.9	-75.5	1.23	4.0
1.000	0.5	3.1	69.6	-72.8	1.26	4.1
1.100	0.2	0.6	70.6	-71.3	1.28	4.2
1.180		0.0	70.9	-70.9	1.29	4.2
1.200						
1.300						
1.370						

Drops with Tucked Knees into the Pool

Height of COM	h = 0.92	m	
Mass of Person	m = 50.79	kg =	112 lb
Density of Water	p_w = 1000.00	kg/m^3	
Density of Person	p_B = 980.00	kg/m^3	
Cross-Sectional Area	A = 0.25	m^2 =	2.6875 ft^2
Length of Person	L = 0.82	m =	2.6875 ft
Volume of Person	V = 0.33	m^3	
Coefficient of Drag	C_D = 1.00		
Gravitational Constant	g = 9.81	m/s^2	

Drag Force Equation $$F_D = \frac{1}{2} C_D A p_w v^2$$

Bouyancy Equation $$F_B = Vg(p_w - p_B)$$

Initial Conditions		
t_o =	0	s
v_o =	3.157	mph

ELAPSED TIME (s)	**VELOCITY AT TIME (mph)**	DRAG FORCE (N)	BOUYANCY FORCE (N)	NET FORCE (N)	DISTANCE (m)	**TOTAL DEPTH (ft)**
0	**7.1**				0.0	**0.0**
0.100	3.8	403.4	18.5	-421.8	0.24	0.8
0.200	2.6	178.7	29.6	-208.3	0.38	1.2
0.300	1.9	93.5	37.4	-130.9	0.48	1.6
0.400	1.4	51.7	43.2	-94.9	0.55	1.8
0.500	1.0	28.2	47.4	-75.7	0.61	2.0
0.530	0.9	23.3	48.5	-71.8	0.62	2.0
0.600	0.7	14.2	50.5	-64.7	0.65	2.1
0.700	0.5	5.8	52.7	-58.5	0.68	2.2
0.800	0.2	1.4	53.9	-55.2	0.69	2.3
0.890		0.0	54.2	-54.2	0.69	2.3
0.900						
1.000						
1.100						
1.180						
1.200						
1.300						
1.370						

Drops Horizontally into the Pool

Height of COM	$h = 0.66$	m	
Mass of Person	$m = 50.79$	kg =	112 lb
Density of Water	$p_w = 1000.00$	kg/m^3	
Density of Person	$p_B = 980.00$	kg/m^3	
Cross-Sectional Area	$A = 0.50$	m^2 =	5.375 ft^2
Length of Person	$L = 0.30$	m =	1 ft
Volume of Person	$V = 0.33$	m^3	
Coefficient of Drag	$C_D = 1.00$		
Gravitational Constant	$g = 9.81$	m/s^2	

Drag Force Equation $$F_D = \frac{1}{2} C_D A p_w v^2$$

Bouyancy Equation $$F_B = Vg(p_w - p_B)$$

Initial Conditions		
t_o =	0	s
v_o =	3.157	mph

ELAPSED TIME (s)	**VELOCITY AT TIME (mph)**	DRAG FORCE (N)	BOUYANCY FORCE (N)	NET FORCE (N)	DISTANCE (m)	**TOTAL DEPTH (ft)**
0	**7.1**				0.0	**0.0**
0.100	2.5	365.3	40.1	-405.4	0.19	0.6
0.200	1.4	113.8	58.5	-172.3	0.28	0.9
0.300	0.9	40.4	69.3	-109.6	0.33	1.1
0.400	0.4	11.0	75.4	-86.4	0.36	1.2
0.500	0.1	0.6	77.9	-78.5	0.37	1.2
0.530		0.0	78.0	-78.0	0.37	1.2
0.600						
0.700						
0.800						
0.890						
0.900						
1.000						
1.100						
1.180						
1.200						
1.300						
1.370						

Drops Vertically into the Pool

Height of COM	$h = 1.38$	m	
Mass of Person	$m = 66.21$	kg =	146 lb
Density of Water	$p_w = 1000.00$	kg/m^3	
Density of Person	$p_B = 980.00$	kg/m^3	
Cross-Sectional Area	$A = 0.09$	m^2 =	1 ft^2
Length of Person	$L = 1.74$	m =	5.70833333 ft
Volume of Person	$V = 0.33$	m^3	
Coefficient of Drag	$C_D = 1.00$		
Gravitational Constant	$g = 9.81$	m/s^2	

Drag Force Equation $$F_D = \frac{1}{2} C_D A p_w v^2$$

Bouyancy Equation $$F_B = V g (p_w - p_B)$$

Initial Conditions		
$t_o =$	0	s
$v_o =$	3.157	mph

ELAPSED TIME (s)	**VELOCITY AT TIME (mph)**	DRAG FORCE (N)	BOUYANCY FORCE (N)	NET FORCE (N)	DISTANCE (m)	**TOTAL DEPTH (ft)**
0	**7.1**				0.0	**0.0**
0.100	5.7	318.0	10.5	-328.6	0.29	0.9
0.200	4.8	221.9	19.2	-241.1	0.52	1.7
0.300	4.1	160.8	26.6	-187.4	0.72	2.4
0.400	3.5	119.4	32.9	-152.3	0.90	2.9
0.500	3.1	89.8	38.3	-128.2	1.04	3.4
0.600	2.7	68.0	43.1	-111.0	1.17	3.8
0.700	2.3	51.3	47.2	-98.5	1.28	4.2
0.800	2.0	38.4	50.7	-89.1	1.38	4.5
0.900	1.7	28.2	53.8	-82.0	1.47	4.8
1.000	1.4	20.2	56.4	-76.6	1.54	5.0
1.100	1.2	13.9	58.6	-72.5	1.60	5.2
1.200	1.0	9.0	60.4	-69.4	1.65	5.4
1.300	0.7	5.2	61.8	-67.1	1.68	5.5
1.400	0.5	2.6	62.9	-65.4	1.71	5.6
1.500	0.3	0.9	63.5	-64.4	1.73	5.7
1.600	0.1	0.1	63.8	-63.9	1.74	5.7
1.640		0.0	63.9	-63.9	1.74	5.7

Drops Diagonally into the Pool

Height of COM	h = 1.12	m	
Mass of Person	m = 66.21	kg =	146 lb
Density of Water	p_w = 1000.00	kg/m^3	
Density of Person	p_B = 980.00	kg/m^3	
Cross-Sectional Area	A = 0.09	m^2 =	1 ft^2
Length of Person	L = 1.23	m =	4.03640121 ft
Volume of Person	V = 0.33	m^3	
Coefficient of Drag	C_D = 1.00		
Gravitational Constant	g = 9.81	m/s^2	

Drag Force Equation $$F_D = \frac{1}{2} C_D A p_w v^2$$

Bouyancy Equation $$F_B = Vg(p_w - p_B)$$

Initial Conditions		
t_o =	0	s
v_o =	3.157	mph

ELAPSED TIME (s)	**VELOCITY AT TIME (mph)**	DRAG FORCE (N)	BOUYANCY FORCE (N)	NET FORCE (N)	DISTANCE (m)	**TOTAL DEPTH (ft)**
0	**7.1**				0.0	**0.0**
0.100	5.7	317.3	14.9	-332.2	0.29	0.9
0.200	4.8	219.8	27.2	-247.0	0.52	1.7
0.300	4.1	157.4	37.5	-194.9	0.72	2.4
0.400	3.5	114.7	46.3	-160.9	0.89	2.9
0.500	3.0	84.0	53.8	-137.8	1.04	3.4
0.600	2.5	61.3	60.2	-121.5	1.16	3.8
0.700	2.1	44.0	65.6	-109.7	1.26	4.1
0.800	1.8	30.8	70.2	-101.0	1.35	4.4
0.900	1.5	20.6	74.0	-94.6	1.43	4.7
1.000	1.1	12.9	77.1	-90.0	1.48	4.9
1.100	0.9	7.2	79.4	-86.6	1.53	5.0
1.200	0.6	3.2	81.1	-84.3	1.56	5.1
1.300	0.3	0.9	82.1	-83.0	1.58	5.2
1.400	0.0	0.0	82.5	-82.5	1.59	5.2
1.500						
1.600						
1.640						

Drops with Tucked Knees into the Pool

Height of COM	$h = 0.94$	m	
Mass of Person	$m = 66.21$	kg =	146 lb
Density of Water	$p_w = 1000.00$	kg/m^3	
Density of Person	$p_B = 980.00$	kg/m^3	
Cross-Sectional Area	$A = 0.27$	m^2 =	2.854167 ft^2
Length of Person	$L = 0.87$	m =	2.85416667 ft
Volume of Person	$V = 0.33$	m^3	
Coefficient of Drag	$C_D = 1.00$		
Gravitational Constant	$g = 9.81$	m/s^2	

Drag Force Equation $$F_D = \frac{1}{2} C_D A p_w v^2$$

Bouyancy Equation $$F_B = V g (p_w - p_B)$$

Initial Conditions		
t_o =	0	s
v_o =	3.157	mph

ELAPSED TIME (s)	**VELOCITY AT TIME (mph)**	DRAG FORCE (N)	BOUYANCY FORCE (N)	NET FORCE (N)	DISTANCE (m)	**TOTAL DEPTH (ft)**
0	**7.1**				0.0	**0.0**
0.100	4.2	511.0	18.2	-529.2	0.25	0.8
0.200	3.0	247.9	30.0	-277.8	0.41	1.3
0.300	2.2	139.4	38.5	-177.9	0.52	1.7
0.400	1.7	83.6	45.1	-128.7	0.61	2.0
0.500	1.4	51.0	50.2	-101.2	0.68	2.2
0.600	1.0	30.5	54.2	-84.6	0.74	2.4
0.700	0.8	17.1	57.2	-74.3	0.78	2.6
0.800	0.5	8.4	59.4	-67.8	0.81	2.7
0.900	0.3	3.1	60.8	-63.9	0.83	2.7
1.000	0.1	0.4	61.6	-62.0	0.84	2.8
1.100						
1.200						
1.300						
1.400						
1.500						
1.600						
1.640						

Drops Horizontally into the Pool

Height of COM	h = 0.66	m	
Mass of Person	m = 66.21	kg =	146 lb
Density of Water	p_w = 1000.00	kg/m^3	
Density of Person	p_B = 980.00	kg/m^3	
Cross-Sectional Area	A = 0.53	m^2 =	5.708333 ft^2
Length of Person	L = 0.30	m =	1 ft
Volume of Person	V = 0.33	m^3	
Coefficient of Drag	C_D = 1.00		
Gravitational Constant	g = 9.81	m/s^2	

Drag Force Equation $$F_D = \frac{1}{2} C_D A p_w v^2$$

Bouyancy Equation $$F_B = V g (p_w - p_B)$$

Initial Conditions		
t_o =	0	s
v_o =	3.157	mph

ELAPSED TIME (s)	**VELOCITY AT TIME (mph)**	DRAG FORCE (N)	BOUYANCY FORCE (N)	NET FORCE (N)	DISTANCE (m)	**TOTAL DEPTH (ft)**
0	**7.1**				0.0	**0.0**
0.100	2.9	506.8	43.1	-549.9	0.21	0.7
0.200	1.7	176.6	64.7	-241.3	0.31	1.0
0.300	1.1	72.8	78.2	-151.0	0.37	1.2
0.400	0.7	27.9	86.8	-114.7	0.41	1.4
0.500	0.3	7.1	91.7	-98.8	0.44	1.4
0.600	0.0	0.1	93.5	-93.6	0.45	1.5
0.700						
0.800						
0.900						
1.000						
1.100						
1.200						
1.300						
1.400						
1.500						
1.600						
1.640						

by
11.2%
Product Solutions
FASTSIGNS
FASTSIGNS
biscuits • bones • treats • desserts
GRAND OPENING
BONGO'S
DOG BISCUITS
upswing
in overall
sales volume
Source: InfoTrends
NINJA CROSS™
NinjaCross MiniNinja Rules
1. Participants must be a minimum of 48-inches tall
2. Participants maximum weight of 275lbs
3. Wait your turn to start, follow direction by facility staff at all times
4. Diving, jumping, running, pushing, etc. is strictly prohibited
5. Participants to use systems solely at their own risk – this is a skill-based system and is meant to be challenging. Owner, operator, manufacturer and any additional parties will not be held responsible for any injury on the system
6. Climbing obstacles cables, structure column legs or any other components on the system is strictly prohibited
7. Touching obstacle frame or support truss, electronics, or any other components other than the obstacles is strictly prohibited
8. Only use if you are capable of safely swimming the length of the pool and able to hold your breath under-water for 10-seconds or more. Non-Swimmers are not permitted.
9. Only 1 participant per obstacle set at a time, no more than 3 participants on the system at one time
10. Use only under supervision of lifeguard or attendant
11. If you fall into water, move on to next obstacle or swim out of the lane
12. If you feel exhausted or weak, stop participation and swim out of lane to closest pool wall
13. Do not push, shove or harass other guests – bullying will not be tolerated and you may be asked to leave the facility
14. Do not use this equipment while under the influence of alcohol or drugs
15. No diving allowed anywhere around this system
16. Leave MiniNinja pool area promptly after completing the course or if you are unable to complete the course
17. Participants assume all risk of injury due to misuse of the NinjaCross MiniNinja or failure to follow rules
NINJA CROSS

NinjaCross Systems

MiniNinja

Standard Operating Procedures and Operations Manual V1.1

Contact Ninja*Cross* Systems at:

Phone- 800-778-9702

Email- Support@NinjaCrossSystems.com

Section 1

Introduction

The purpose of this operations manual is to provide the owner/operator with the basic rules and maintenance information necessary to operate the NinjaCross MiniNinja System in a manner designed to minimize problems and ensure the safety of the participant(s). This manual deals with the operation of the NinjaCross equipment only. It does not address pool operations, health codes, water quality, or local ordinances.

Facilities should follow the manufacturer's guidelines for installation, safe inspection, maintenance, operations and use of its various fitness systems and features. However, your employer should provide you with a specific set of guidelines and training if you are responsible for these inspections

Most local regulatory agencies have public swimming pool standards. It is recommended that local codes, regulations, and guidelines be followed. This will insure a harmonious relationship between the pool/slide operation and the local authorities.

To assist owners and operators in providing a safe, fun, and enjoyable experience for all facility patrons, NinjaCross Systems provides the following additional services;

- Annual NinjaCross Inspections
- Annual on-site safety training for lifeguards and operators
- Maintenance programs to prolong the life of your investment

Section 2

Terms

Box Truss - a type of truss that uses four major cords with connecting cords to form a strong structure that takes the shape of a rectangular box.

Corner Block - a 12” square aluminum block that mounts to the Aluminum Box truss section. All Static Lines attach at a Corner Block and all cross members of the Obstacle Frame attached at Corner Blocks.

Designated Safety Area - the area that includes all pool space under the obstacle frame and the adjacent 8-feet on either side of the Obstacle Frame stretching from end of pool to opposite end.

Eye Clamp - A clamp that allows attachment of a NetForm Rope or other item to the Obstacle Frame.

Mounting Plate - the square aluminum plate that secures the Obstacle Frame to the pool deck. The plate is anchored by wedge anchors.

NetForm Rope - the rope that connects an obstacle to the Obstacle Frame

Obstacle - a combination of aluminum parts, ropes, and hardware that create a means for the participant to traverse.

OAB (Obstacle Attachment Bar) - An aluminum bat that attached to the Obstacle Frame and allows Obstacles with dual ropes to be attached.

Obstacle Frame - the aluminum truss that Obstacles hang from, Static Cables and Lifting Cables attach to, and BackUp System attaches to.

Obstacle Frame Leg - the aluminum truss vertical sections that hold the Obstacle Frame at elevation. These legs are mounted to the pool deck via the Mounting Plates.

Participant - the guest that is using the NinjaCross MiniNinja system

Pinch Block - an aluminum block with indents that allows it to secure into the tube of the Obstacle Frame. Used for connecting Obstacles to the Obstacle Frame.

Safety Padding - a section of padding applied to deck and pool wall that protects participant from falls against the pool deck.

Swivel Clamp - A dual clamp system that allows attachment of the OAB to the Obstacle Frame.

NinjaCross MiniNinja Standard Rules

1. Follow the directions of facility personnel at all times
2. Wait your turn prior to starting
3. Diving, jumping, running, pushing, etc. is strictly prohibited
4. Participants to use system solely at their own risk - this is a skill-based system and is meant to be challenging
5. Climbing obstacle cables, legs, or any other components on their system is strictly prohibited
6. Touching obstacle frame or support truss, electronics, or any other components other than the obstacles is strictly prohibited
7. Do climb the ropes or onto the Obstacle Frame. Do not try to hold onto the Obstacle Frame
8. Only use if you are capable of swimming and able to hold your breath under water for 10-seconds or more
9. Only one participant per obstacle set at a time. A maximum or 2 participants may be on a single lane at any one time. The minimum distance between participants shall be no less than 10'
10. Use only under the supervision of lifeguard or attendant
11. Swinging, leaping, jumping, or swimming in adjacent lane is strictly prohibited
12. No standing on Above Water Level obstacles
13. If you fall on an obstacle, move onto the next obstacle and attempt to complete
14. If you feel exhausted or weak, stop participation and swim out of lane to closet pool wall
15. Do not push, shove, or harass other guests - bullying will not be tolerated, and you will be asked to leave facility.
16. Recommended Minimum age 5 years old
17. Minimum Height 48" tall
18. Maximum Weight 270lbs
19. Participant must not wear lifejacket, shoes (including swim shoes), loose jewelry, or other item of clothing that may get caught in obstacles
20. Lifeguards are responsible for final determination of swim ability, age, and height according to the existing rules of the facility.
21. Intoxicated person are not allowed to use the system or operate the system
22. No spectators in the designated safety area of the pool

Section 2

End of Day Procedures

End of Day Washdown

•This procedure should be followed on a daily basis

• Rinse the Obstacle Frame including the Ropes, Plates, and other attachments with fresh water

Section 3

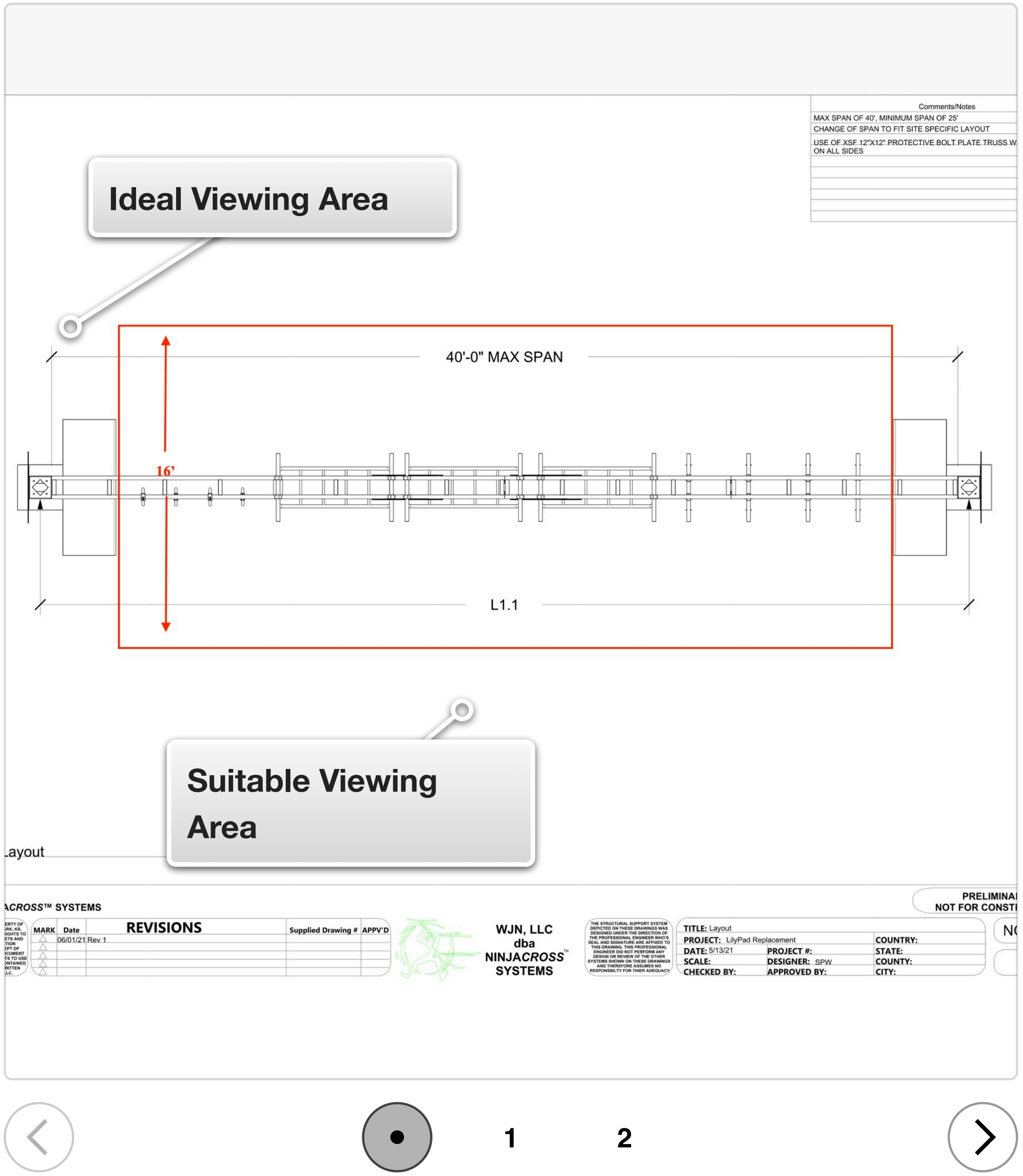
Designated Safety Area

he Designated Safety Area is the zone where only participants may be in the pool during the operating time of the NinjaCross MiniNinja System. The safety area is detailed as the area directly under the Obstacle Frame as well as an additional 8-feet on either side of the Obstacle Frame stretching from end of pool to end of pool.

During operations, spectators are prohibited from entering the Designated Safety Area.

Participants who quit the course without finishing shall be instructed to exit the course to the outside of the Designated Safety Area without crossing the path of other participants and exit the Designated Safety Area as quickly and safely as possible.

Interactive 3.1 Designated Safety Area



Section 4

Seasonal Shut Down Procedures

Long Term Shutdown

Procedures

When storing the Ninja*Cross* MiniNinja system for winter or long-term storage, the following steps should be taken.

1. Remove all obstacles and store in a secure safe location. Take care in storing obstacles as to not damage the materials or coating.

2. Store Ropes in a dry location free of any chemicals.

Section 1

Obstacle Types

There are two types of obstacles with the NinjaCross MiniNinja System a) OAB mounted obstacles, and b) Direct frame mounted obstacles.

OAB mounted obstacles are those obstacles that use 2 or more cables attached to the obstacle and require a spacing of more than 12” between the NetForm ropes. The OAB attaches to the Obstacle Frame by way of 2 Swivel Clamps. Obstacles attach to the OAB via the stud connection on the OAB and the shackles of the NetForm Rope.

Examples of OAB Mounted Obstacles are:

Trapeze Bars   Low Bars   Ladders

Direct frame mounted obstacles are those obstacles that attach to the Obstacle Frame directly by use of an Eye Clamp or other method.

Examples of Direct Mounted Obstacles are:

Sea of Discs   Overhead Rings   CannonBall Alley

Section 2

Obstacle Mounting Procedures

In order to mount any obstacle using a Swivel Clamp or Eye Clamp the following procedures need to be followed

1. Ensure that the Obstacle Frame is fully deployed in its operational position and the pool is clear of all swimmers.

2. Choose location for obstacle to be mounted.

3. Choose correct type of clamp for the obstacle to be installed

4. Unscrew the wing nut on the clamp to allow clamp to easily open

5. Place clamp in position, close the clamp over the Obstacle Frame tube, close bolt into clamp tab ensuring that the wing nut and washer clear the top of the clamp.

6. Tighten the wing nut until snug, do not over tighten as damage may occur to the Obstacle Frame truss

7. Attach obstacle to Eye Clamp or attach OAB to Swivel Clamps.

   a. If using an Eye Clamp, open the shackle at end of the NetForm Rope by turning the shackle pin counterclockwise using an Allen wrench. Place shackle over the open eye of the clamp and insert shackle pin into the shackle through the eye of the clamp. Tighten shackle pin (the use of blue Loctite will ensure shackle does not come loose.)

   b. If using an OAB, open the shackle at end of the NetForm Rope by turning the shackle pin counter-clockwise using an Allen wrench. Place shackle over the open stud of the OAB and insert shackle pin into the shackle through the stud of the OAB. Tighten shackle pin (the use of blue Loctite will ensure shackle does not come loose.)

When moving Obstacles from initial installed location, please refer to the Obstacle Water Depth Chart included in this manual to ensure obstacles are installed over the proper depth of pool.

Access to truss can be by use of a secured ladder in the pool leaned up against the Obstacle Frame or by use of the EZ Dock floating dock system. Care must be taken to not put excessive lateral force on the Obstacle Frame at any time, and at no time should staff sit, stand, or walk on the Obstacle Frame for access.

Obstacle Water Depth

Obstacle	Min Water Depth in Feet
Overhead Rings	4
Rising Rings	4
Cannonball Alley	5
Low Bar	4
Trapeze Bar	4
Ladder	4
Camelback	5

Section 3

Obstacle Frame

The Obstacle Frame is a 12”x12” aluminum box truss connected by way of Corner Blocks. The Obstacle Frame is the connection point for all Obstacles. The Obstacle Frame is designed to distribute the weight of the Obstacles and participants over a specified range according to the individual design of each system.

The Obstacle Frame is bolted together with 5/8”x2.5” Stainless Steel or Galvanized Bolts. The bolts utilize 5/8” washers and 5/8” nylon washers. The Nylon Washers prevent galvanic reactions from occurring on the different metal types of the bolts and Obstacle Frame.

12”x12” 6-way Corner Blocks are installed every at the vertical legs. All cross members of the Obstacle Frame are connected at Corner Blocks. Corner Blocks utilize the same 5/8” hardware as other parts of the Obstacle Frame.

Obstacle Frame Maintenance

Cleaning

Powder coated aluminum should require little maintenance, other than to gently clean with water and a mild liquid detergent to remove any dirt or splashes. A microfiber cloth or sponge should be used to wipe over the surfaces of the furniture. Removing surface water with a drying cloth (like you would use on your car) will help avoid water spots. Avoid using any abrasive cleaning agents or materials, as these could mark the surface of the powder coat. Do not use steel wool or Scotch-Brite on powder coated surfaces.

Section 2

Obstacle Maintenance

Aluminum Obstacles

Cleaning

Powder coated aluminum should require little maintenance, other than to gently clean with water and a mild liquid detergent to remove any dirt or splashes. A microfiber cloth or sponge should be used to wipe over the surfaces of the furniture. Removing surface water with a drying cloth (like you would use on your car) will help avoid water spots. Avoid using any abrasive cleaning agents or materials, as these could mark the surface *of the powder coat. Do not use steel wool or Scotch-Brite on powder coated surfaces.*

Paint and Coatings Care

Over the course of use, the obstacles will receive chips and scraps on the coated surfaces. It is important that these chips and scraps be attended to as soon as they are discovered to prevent them from worsening. When a chip or scrap is discovered it is important to follow these procedures.

1. Remove obstacle from the water
2. Completely dry the obstacle and wipe clean any dirt or residues
3. Apply touch up paint to effected area
4. Allow paint to completely dry before allowing obstacle to get wet

Ropes

Cleaning

Rinse with clean fresh water, do not use chemicals or abrasives.

Section 3

Material Specific Maintenance

The following pages have information on the proper methods for cleaning specific types of metals found in the Ninja*Cross* MiniNinja System. If you have any questions, please contact Ninja*Cross* Systems for advise.

Care and Cleaning of Stainless Steel

Introduction

Cleanliness and stainless steel are closely related and, in many applications, each is dependent upon the other. In the handling of food, chemicals, pharmaceuticals and in the use of stainless steel as a construction material (roofs, wall panels, entry ways, signs, etc.), stainless steel provides the degree of corrosion resistance that is necessary to prevent product contamination or surface rusting. However, stainless steel performs best when clean — cleanliness is essential for maximum resistance to corrosion.

This handbook describes various practices for cleaning stainless steel during manufacture and in use. This includes methods for removing free-iron contamination on stainless steel surfaces that may have been picked up from metalworking tools; and for removing general accumulation of dirt, grime and surface stains that occur during normal handling and exposure to the elements.

The reader should keep in mind that there are few specific rules for a cleaning procedure. Accordingly, the methods discussed in this handbook are suggestions. Each manufacturer or user, after obtaining competent advice with respect to their individual requirements, should select methods appropriate to those requirements.

What is Stainless Steel?

Stainless steel is not a single alloy, but rather the name applies to a group of iron-based alloys containing a minimum 10.5% chromium. Other elements are added and the chromium content increased to improve the corrosion resistance and heat resisting properties, enhance mechanical properties, and/or improve fabricating characteristics. There are over 50 stainless steel grades that were originally recognized by the American Iron and Steel Institute (AISI). Three general classifications are used to identify stainless steel. They are:

1) Metallurgical structure.

2) The AISI numbering system (200, 300 and 400 series numbers).

3) The Unified Numbering System, which was developed by the American Society for Testing Materials (ASTM) and the Society of Automotive Engineers (SAE) to apply to all commercial metals and alloys.

The various types of stainless steel are detailed in a designer handbook, “Design Guidelines for the Selection and Use of Stainless Steel,” available from the Specialty Steel Industry of North America (SSINA). Several other publications are also available, including: “Stainless Steel Fabrication,” “Stainless Steel Fasteners,” “Stainless Steel Finishes,” “Stainless Steel Specifications,” and “Stainless Steel Architectural Facts,” to mention a few.

Alloy Types

304 is the basic chromium-nickel austenitic stainless steel and has been found suitable for a wide range of applications. It is the most readily available in a variety of product forms. This grade is easy to form and fabricate with excellent resistance to corrosion.

•304L is the low carbon version of 304. It is sometimes specified where extensive welding will be done.

•316 offers a more corrosion-resistance through the addition of molybdenum. This grade is desirable where the possibility of severe corrosion exists, such as heavy industrial atmospheres and marine environments.

•316L is the low carbon version of 316.

•430 is a straight chromium ferritic stainless steel with lower corrosion resistance than the 300 series. It is principally employed for interior use.

Cleaning of Stainless Steel

Stainless steels need to be cleaned for aesthetic considerations and to preserve corrosion resistance. Stainless steel is protected from corrosion by a thin layer of chromium oxide. Oxygen from the atmosphere combines with the chromium in the stainless steel to form this passive chromium oxide film that protects from further corrosion. Any contamination of the surface by dirt, or other material, hinders this passivation process and traps corrosive agents, reducing corrosion protection. Thus, some form of routine cleaning is necessary to preserve the appearance and integrity of the surface. Stainless steels are easily cleaned by many different methods. They actually thrive with frequent cleaning, and unlike some other materials, it is impossible to “wear out” stainless steel by excessive cleaning. The effect of surface/pattern roughness, grain/pattern orientation and designs that allow for maximum rain cleaning (exterior applications)should be considered.

Types of surface contaminants

• Dirt -Like any surface that is exposed to the environment, stainless steel can get dirty. Dirt and soil can consist of accumulated dust and a variety of contaminates that come from many sources, ranging from the wind to everyday use. These contaminates will vary greatly in their effect on appearance and corrosively and ease of removal. While some may be easily removed, others may require specific cleaners for effective removal. It may be necessary to identify the contaminate or experiment with various cleaners. Frequently, warm water with or without a gentle detergent is sufficient.

Next in order are mild non-scratching abrasive powders such as typical household cleaners. These can be used with warm water, bristle brushes, sponges, or clean cloths. Ordinary carbon steel brushes or steel wool should be avoided as they may leave particles embedded on the surface which can lead to RUSTING. For more aggressive cleaning, a small amount of vinegar can be added to the scouring powder. Cleaning should always be followed by rinsing in clean hot water. When water contains mineral solids, which leave water spots, it is advisable to wipe the surface completely with dry towels.

• Fingerprints and Stains -Fingerprints and mild stains resulting from normal use in consumer and architectural applications are the most common surface contaminates. Fortunately, these usually affect only appearance and seldom have an effect on corrosion resistance. They are easy to remove by a variety of simple cleaning methods. Fingerprints are probably the most troublesome marks to remove from the surface of smooth polished or bright finished stainless steel. Fortunately, they can be removed with a glass cleaner or by gentle rubbing with a paste of soda ash (sodium carbonate) and water applied with a soft rag. Once again, this should be followed by a thorough warm water rinse. There are several special surface finishes where fingerprints present special problems: polished No. 6, etched, some abrasive blasted finishes, and light electrochemical colors applied over satin or brushed finishes.

(NOTE: there are several special finishes designed to withstand fingerprints: embossed, swirl patterns, lined patterns, etc.).

• Shop oil and Grease -Shop oils, which may carry grease, grit and metal chips, commonly produce surface soiling after many shop operations. Greases and other contaminates may also soil surfaces in food preparation and many other household and commercial situations. These soils may be corrosive in themselves or may not allow the surface to maintain passivity, and so periodic removal is a necessity. Initially, soap or detergent and water may be tried or a combination of detergent and water plus a solvent. The removal of oil and grease from stainless steel parts by immersion in chemical solvents is frequently used with cold-formed or machined parts that are laden with lubricants. This process, in its simplest form, consists of bringing liquid solvent into contact with the surface to be cleaned and allowing dissolution to take place; for example, washing a surface with trichloroethylene or similar liquid or stirring a batch of small parts in a container of solvent. Non-halogenated solvents, such as acetone, methyl alcohol, ethyl alcohol, methyl ethyl ketone, benzene, isopropyl alcohol, toluene, mineral spirits, and turpentine work well.

Many of these solvents are widely used as individual cleaners, but there are thousands of blended or compound cleaners on the market. Users are advised to contact suppliers of solvents for information on their applications on stainless steel.

Types of Cleaners and Methods

General Precautions

In selecting cleaning practices, consider the possibility of scratching and the potential for post-cleaning corrosion caused by incompletely removed cleaners. Scratching can occur on a bright mirror finish by cleaners that contain hard abrasives, or even by “grit” in wash water. This is usually not a problem on dull finishes, or those surfaces finished with a coarse polishing grit. The best preventative measure is to avoid using abrasive cleaners unless absolutely necessary. When abrasives are needed, first experiment on an inconspicuous area. A “soft abrasive,” such as pumice, should be used. Abrasives can permanently damage some colored and highly polished finishes. Advice should be obtained from the finish supplier when cleaning special finishes. Many cleaners contain corrosive ingredients which require thorough post-clean rinsing with clean water; however, thorough rinsing is recommended for all cleaning procedures.

• **Clean Water and Wipe** - The simplest, safest, and least costly method that will adequately do the job is always the best method. Stainless surfaces thrive with frequent cleaning because there is no surface coating to wear off stainless steels. A soft cloth and clean warm water should always be the first choice for mild stains and loose dirt and soils. A final rinse with clean water and a dry wipe will complete the process and eliminate the possibility of water stains.

• **Solvent Cleaning** -Organic solvents can be used to remove fresh fingerprints and oils and greases that have not had time to oxidize or decompose. The preferred solvent is one that does not contain chlorine, such as acetone, methyl alcohol, and mineral spirits. There are many compounded or blended organic cleaners that are commercially available and attempt to optimize both clean ability and safety attributes. Cleaning can be accomplished by immersing smaller articles directly into the solvent, wiping with solvent-impregnated cloths, or by sophisticated vapor or spray methods. The wiping technique sometimes leaves a streaked surface.

Effective Cleaning Methods

• **Household Cleaners -** Household cleaners fall into two categories: detergent (non-abrasive) and abrasive cleaners. Both are effective for many mild dirt, stain, and soil deposits, as well as light oils such as fingerprints. The abrasive cleaners are more effective but introduce the possibility of scratching the surface. However, the degree of abrasiveness will vary greatly with the particular product, and some brands will produce noticeable scratching on only the most highly polished and some colored surfaces. All of these cleaners vary widely with respect to their acidity and the amount of chloride they contain. A neutral cleaner low in chloride is preferred unless the user is assured that the surface can be thoroughly rinsed after cleaning. The fact that the label states “for stainless steel” is no guarantee that the product is not abrasive, not acidic, or low in chloride. The cleaning method generally employed with these cleaners is to apply them to the stainless surface and follow by cloth wiping, or to wipe directly with a cleaner-impregnated soft cloth. In all cases, the cleaned surface should be thoroughly rinsed with clean water and wiped dry with a soft cloth if water streaking is a consideration.

• **Commercial Cleaners -** Many commercial cleaners compounded from phosphates, synthetic detergents, and alkalis are available for the cleaning of severely soiled or stained stainless surfaces. When used with a variety of cleaning methods, these cleaners can safely provide effective cleaning. Manufacturers should be consulted and their recommendations followed whenever using cleaners of this kind. The general precautions stated above also pertain to these cleaners.

Care of Stainless Steel

The cleaner stainless steel can be kept while in storage, being processed or during use, the greater the assurance of optimum corrosion resistance. Some tips on the care of stainless steel are listed below:

1) Use paper or other protective wrapping on the surface of the stainless steel until processing is complete.*

2) Handle stainless steel with clean gloves or cloths to guard against stains or finger marks.

3) Avoid the use of oily rags or greasy cloths when wiping the surface.

4) Do routine cleaning of exposed surfaces. Buildings with window washing systems can utilize this method to clean exterior panels.

5) Where possible, after cleaning, rinse thoroughly with water.

6) Cleaning with chloride-containing detergents must be avoided.

7) Even the finest cleaning powders can scratch or burnish a mill-rolled finish. On polished finishes, rubbing or wiping should be done in the direction of the polish lines, NOT across them.

8) **DO NOT USE SOLVENTS** in closed spaces or while smoking.

*Many adhesive-backed papers and plastic sheets or tape applied to stainless steel for protection “age” in fairly short periods of time and become extremely difficult to remove.

Manufacturers should be contacted regarding information as to how long protective films or paper can be left in place.

Acknowledgments

The Specialty Steel Industry of North America (SSINA) acknowledges that this new handbook contains information originally published by the Committee of Stainless Steel Producers, American Iron and Steel Institute, which no longer exists. Current SSINA member companies were represented on that committee. The SSINA wishes to acknowledge the contributions of the Nickel Development Institute and its consultant, Technical Marketing Resources (Pittsburgh, PA) for help in preparing the contents of this handbook.

The Specialty Steel Industry of the North America (SSINA) and the individual companies it represents have made every effort to ensure that the information presented in this handbook is technically correct. However, neither the SSINA nor its member companies warrants the accuracy of the information contained in this handbook or its suitability for any general and specific use. The SSINA assumes no liability or responsibility of any kind in connection with the use of this information. The reader is advised that the material contained herein should not be used or relied on for any specific or general applications without first securing competent advice.

Powder Coating Care and Maintenance

Proper Care of Powdered Surfaces Is Essential

Powder coatings that are applied to metal products exposed to the weather will inevitably degrade over time. A number of conditions, including those found in nature, will contribute to shortening the life of this type of protective finish.

•Sun

•Rain

•Wind

•Pollution

•Cold weather

•Salt water

•Electrical current

•Dissimilar metals

How to Maintain Powder Coated Surfaces

1. Avoid harsh chemicals: Unlike spray paint, powder coating is much more resistant to things like rust, corrosion, peeling and fading. However, that resistance does not mean it's completely fine to use chemical cleaners and solvents to clean powder coated items. Harsh cleaners and solvents like acetone can actually damage powder coating.

2. Clean gently: You can still clean powder coated surfaces. Just wipe off dust with a soft clock. If more cleaning is necessary, use a highly diluted, mild soap in water and a soft towel or soft sponge to very gently clean. Rinse with a little water, then dry with another soft towel.

3. Wax: If your powder coated metal has lost its gloss and shine, after removing dirt with mild soap, you can apply a thin layer of wax just like you do after you wash your car. After the wax dries, wipe all of it off and powder coated metal will look like new.

4. Don't paint: If you're wondering if you can touch up imperfections and rust with paint, the answer is no. Because of how the powder coating process works, paint won't adhere to powder coated surfaces. If your powder coating is starting to show signs of wear and tear, it's time to have a professional either repair or redo the powder coating.

5. Maintenance schedules: We recommend you regularly inspect and clean your powder coated items. How often you wipe your metal surfaces clean depends on the amount of dirt and grime in the area, the time of year, and if there's been any intense weather like a hurricanes or tornados.

NetForm Ropes

System Inspection

NetForm structures and associated hardware including backing nets, cables and fasteners should be inspected by a competent person after installation and on a regular scheduled basis thereafter. It is good practice to keep a dated and signed maintenance log of each netting system to assure that all safety measures have been followed.

The system must be inspected following alterations, repairs and impact loading. If any welding or cutting operations occur near the structures, weld protection must be provided for that area, and more frequent inspections should be conducted in proportion to the dangers involved.

NetForm should be inspected on a daily and weekly basis.

• Daily Inspection should include a quick visual of the NetForm and any backing netting, to look for any obvious broken net mesh or frays. Report for replacement any missing NetForm cross joints or tees.

• Weekly Inspection should include any lashing cord that may be used in the NetForm system, including loose and broken lashes. Repair as necessary. Visually check and hand-test all rope handrails, hardware, cables, anchors, etc. All hardware should be in place with no substitutes. Document any faults with a photograph to help expedite repairs.

General Environmental Inspection

NetForm, backing nets or hardware that show deterioration from mildew, corrosion, wear, or stress, that may affect their strength, must be immediately removed from service for further inspection, repair or disposal.

• Inspect the NetForm and backing nets for cuts, pulls, fraying of material and discoloration indicating material aging.

• Inspect cross joints and tees for stress cracking.

• Inspect support cables for cuts, twists, kinks, fraying of strands and corrosive rust.

• Inspect support and anchor hardware to assure fasteners are properly secured and that no pieces are missing. Look for damaging rust that may affect hardware strength or abrade the NetForm or backing nets.

Repairs

Field repairs and modifications may be done with guidance and materials from the manufacturer. Photographs are always the best way to convey the extent of a fault area. If replacement of a net panel or system is required, the manufacturer will determine the best method of replacement.

ABS Wrap/Signage Care

• Clean debris from wraps and signage as they appear dirty. Failure to remove debris may make care more difficult over time.

• Test any cleaning solutions on a small section of wrap before using to clean wrap.

• Use a wet, non-abrasive detergent and a soft clean rag for cleaning.

• Rinse thoroughly with clean water. Dry with a microfiber cloth.

• If choosing to wax the wrap, use only waxes that do not contain petroleum distillates

• Do not use mechanical brushes or pressure washers to clean the wraps. Doing so may damage the graphics or wraps themselves.

Vertical Truss Leg Wraps are not included in base MiniNinja System. NinjaCross Systems suggests the use of wraps to prevent access to the Obstacle Frame.

Section 1

Daily Pre-use Inspections

Prior to use each day, the system must undergo a complete Pre-use Daily Inspection to ensure that the system components are in proper working order and ready for use. This is a comprehensive inspection that is done at start of each day.

The complete system SHALL undergo the following inspections as laid out and documented. Any problems, concerns, or points of interests SHALL be noted in the inspection logs for review by NinjaCross Systems.

1. Ensure that the Obstacle Frame Legs are secured to the mounting plates.

2. Ensure Obstacle Frame is secure and not damaged.

3. Ensure that all Obstacles are in proper placement and not entangled in the Obstacle Frame, OAB's, or Signage.

4. Check the pool and surrounding deck for parts, hardware, or materials that may have fallen.

5. Ensure all Obstacles are at their proper depth in the pool and are located as designed.

6. Inspect NetForm Ropes for damage, broken strands, or opening or fraying. Check for mildew or staining.

7. Have lifeguards run through both lanes to ensure system is operating correctly.

8. Ensure that all signage is undamaged, visible without obstructions, and can be viewed by participants on the deck.

9. Document inspection and note any concerns or problems.

Quarterly Inspection

The complete system **SHALL** undergo the following quarterly inspections as laid out and documented. Any problems, concerns, or points of interests **SHALL** be noted in the inspection logs for review by NinjaCross Systems.

1. Obstacle Frame -

a. Check that Obstacle Frame joints, where two Truss Sections meet or a Truss Section and Corner Block meet, are secure and not loose.

b. Ensure that all hardware is present at every joint, each Truss Section is bolted to a Truss Section or Corner Block with 4 bolt assemblies.

c. Check for chipped paint

d. Checked for cracked paint, cracked paint may indicate a stress fracture in the truss cord.

e. Ensure that the Obstacle Frame is level both side to side and front to back

f. Rinse frame with fresh water

2. Obstacles -

a. Ensure that there are no broken welds

b. Ensure cables are not frayed, dog-legged, or damaged.

c. Ensure all connection of obstacles are secure and not loose

d. Repair any damage to painted surfaces.

Section 3

Yearly Inspection

All NinjaCross MiniNinja System components **SHALL** be inspected annually by NinjaCross Systems or an authorized representative. Failure to have the system inspected will result in NinjaCross Systems notifying all relevant inspection authorities that the system cannot be declared safe to use by manufacturer.

A minimum of 4-weeks' notice to NinjaCross Systems must be given for scheduling the annual inspection. Contact NinjaCross Systems via your sales contact or directly at Support@NinjaCrossSystems.com

Annual Inspection **SHALL** include and inspection of the following items to ensure the safe and proper working order of the NinjaCross MiniNinja System.

1. Obstacle Frame System including mounting plate
2. Obstacles
3. Inspection and Maintenance Logs

Section 4

Inspection Forms

Ninja*Cross* Systems has provided the following sample inspection forms for use or as a guideline to creating your own inspection forms. At minimum, all inspection forms must include the items including in each form.

Inspection Forms

Ninja*Cross* : Daily Pre-use Inspection

Description : Daily safety checks to be performed prior to use.

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	Monthly
Obstacle Frame Mounting Plate																																
Obstacle Frame																																
Obstacle Ropes																																
Obstacles																																

Notes :

Inspection Forms

Ninja*Cross* : Quarterly Inspection

Description : System inspection every 3 months

	1st Quarter	2nd Quarter	3rd Quarter	4th Quarter
Obstacle Mounting Plate and Anchors				
Obstacle Frame Connections				
Obstacle Connections				
Obstacle Rope integrity				
Obstacle integrity				

Notes :

Certification and Training

Detailed instructions, extensive training, and actual operations specific to each NinjaCross MiniNinja System will be provided and addressed during the on-site Training and Certification conducted by The Owner/Operator of the MiniNinja System. The Owner/Operator will be responsible for instructing the operations team on Operations, Daily, Quarterly, Seasonal and Annual Inspections, Safe Usage, Procedures to follow in order to minimize possible injuries as well as cleaning and maintenance to

insure the longevity of your obstacle course & fitness system.

Personnel Training

(Please Note the Following Contains the Manufactures Minimum Recommendations but are Subject to Your Facilities Local and State Codes as well as contracted Third Party Organizations such as the American Red Cross)

Having properly trained and conscientious employees on site is the most important safety factor in the operation of the NinjaCross MiniNinja System.

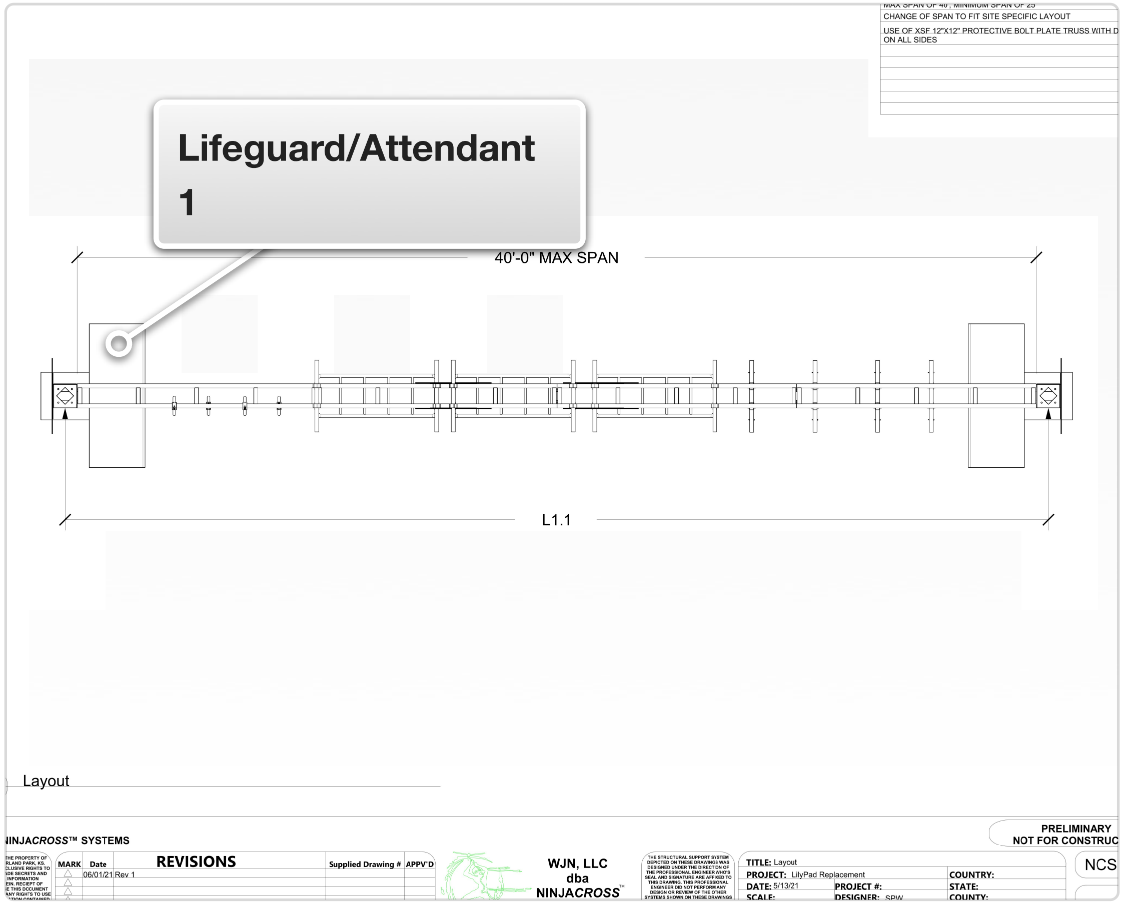
It is our recommendation that all employees who are responsible for the NinjaCross MiniNinja System operations be certified lifeguards and be qualified in both first-aid and life-saving techniques through the American Red Cross training or the equivalent. At least one person who has completed the Standard First Aid and Personal Safety course, as offered by the American Red Cross, or the equivalent should be on duty always during operating hours. This person should also be competent in carrying out any emergency procedures peculiar to the slide he or she is operating. Under most conditions, this is also a recommendation of the insurance carrier if applicable.

Each owner/operator shall have written operating procedures for the NinjaCross MiniNinja System, which are an integral part of their staff-training program. These procedures shall include but not be limited to:

Lifeguard/Attendant Station 1 - one trained lifeguard/attendant SHALL be stationed at the edge of the pool at the starting location. This staff duties are to ensure that all Participants start in the water, to ensure the proper spacing of Participants at the start, and to observe Participants at the start of the course.

All NinjaCross MiniNinja personnel should be alert to controlling crowd behavior and the proper entry rate into the pool; therefore, we recommend the line to participate be formed on the pool deck rather than the pool edge. One Participant may be stationed at the edge of pool to start the course, while any additional may be at a point away from the pool edge preparing to move into starting position at the command of the lifeguard/attendant. Once the Participant who is at edge of pool starts the course the Participant

Interactive 7.1 Lifeguard/Attendant locations



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on the deck enters the starting area at the edge of the pool then the line then moves up one position.

Lifeguards at the start of the course should address each and every Participant when it is their turn and then inform the Participant on the rules of the course prior to starting the course. All Participants should be instructed how to use the course and not allowed to run, jump, or leap into the pool. The Lifeguard(s) stationed at start will address each Participant first by asking that they follow their instructions and Do Not proceed into the pool until they are given the okay to do so.

Safe and orderly exit from the pool area helps reduce the risk of disoriented riders colliding with other pool guests. Lifeguards shall instruct Participants to exit the Designated Safety Area in the correct manner and direction.

An uninterrupted view of the pool and Obstacle Frame must be maintained at all times. It is recommended that all lifeguards be familiar with all the jobs related to the Obstacle Frame. Rotating lifeguards between positions keeps interest and attention high.

Facility Requirements

Communications

Each facility shall ensure they have a communication plan in place for all staff working the NinjaCross MiniNinja System and have trained them in the proper use of signals, devices, or other methods.

Signage:

The owner/operator shall place signage as specified. These signs shall include safety, warning, and instructional signage reflecting manufacturer recommendations. Signage shall be prominently displayed at the course entrance or other appropriate area and shall include but not be limited to:

•**Instructions, which include:**

•Expected participant conduct,

•Dispatch procedures,

•Exiting procedures, and

•Obey attendant/lifeguard instructions.

•**Warnings, which include:**

•NinjaCross MiniNinja characteristics, such as challenging & competitive

•Water depth if not posted near pool edge already

•**Requirements which include:**

•Participants being free of medical conditions, including but not limited to pregnancy and heart, back, or musculoskeletal problems,

•Mental conditions that may prevent comprehension or adherence to posted rules,

•Maximum/minimum height and weight, and

•Any swimming or physical ability requirement or both.

Section 1

System Overview

Your Ninja*Cross* MiniNinja System is an indoor or outdoor system that includes the deck mounted anchor points and mounts. This section will give an overview of the different materials that make up the components of the system.

Stainless Steel Components

1. Bolting Hardware
2. Shackles

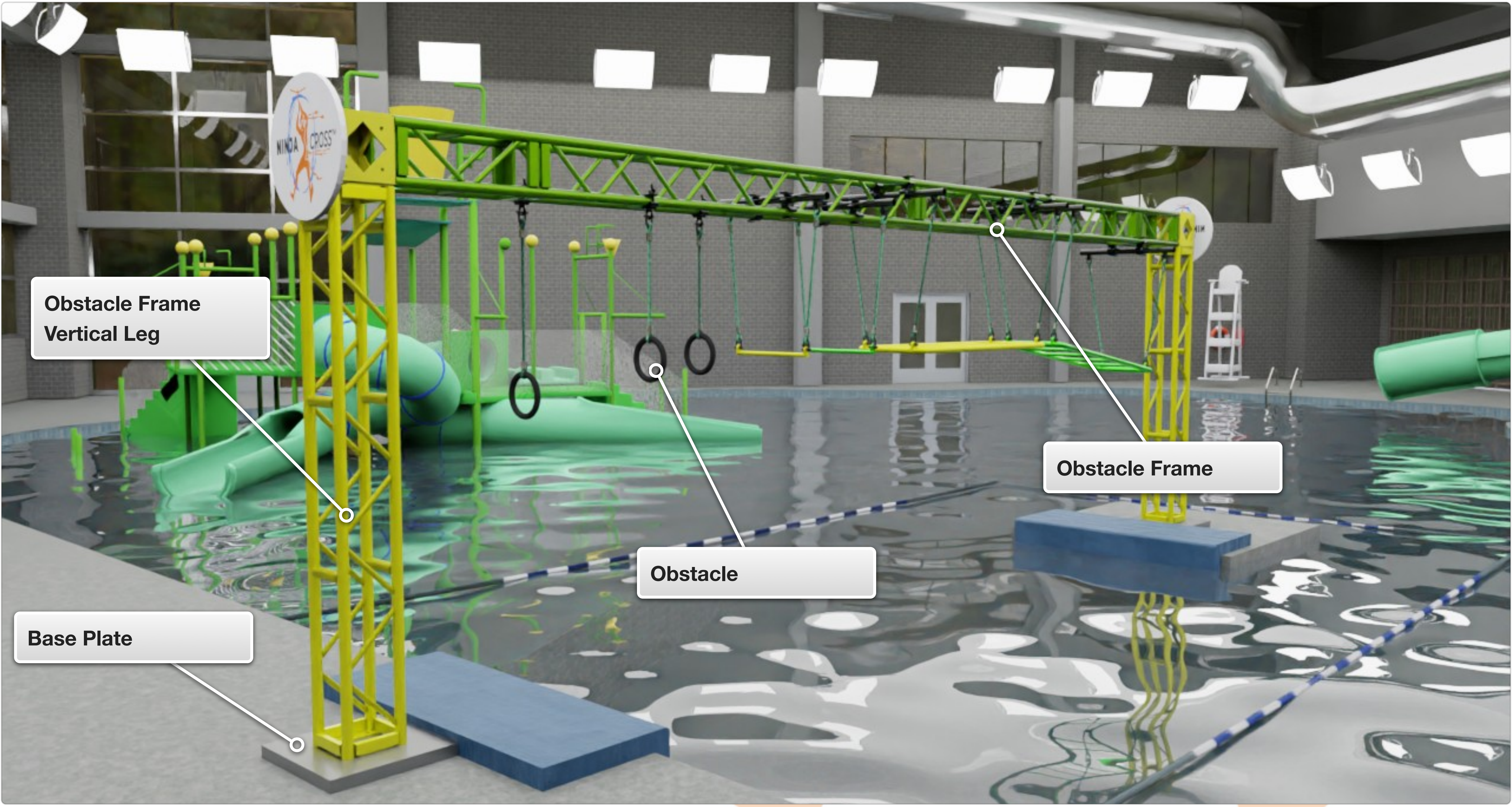
Aluminum Components

1. All metal Obstacles and OAB's
2. Obstacle Frame Truss and Corner Blocks
3. Truss Picks and Clamps

Other Materials

1. Signs - ABS
2. Backup System - powder-coated steel with galvanized cable
3. Ropes - InCord NetForm, Polyester Fiber Braided Steel Wire
4. Discs, Rings, and other Obstacles - HDPE

Interactive 8.1 System Overview



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Obstacle Frame Components

The Obstacle Frame consists of 3 primary components

1. 12”x12” Box Truss

2. 12” 6-way Corner Blocks

3. Mounting Plate

The parts of the Obstacle Frame System include:

1. **12”x12” Box Truss -** this aluminum box truss comprises the main structural component of the Obstacle Frame. Each section is at maximum 10’ long with the shortest being 2’ long. The type of Box Truss used is a bolt plate type that utilizes 5/8” bolt hardware.
2. **12”x12” 6-Way Corner Block -**is a 12” square block used to connect sections of Box Truss. The block is the only point where Static Lines are permitted to be installed.
3. **Mounting Plate -** this is a square aluminum plate designed to allow anchorage of the MiniNinja system to the concrete deck. The Mounting Plate is secured to the deck via wedge anchors and secured to the vertical Box Truss legs via bolting hardware.

Gallery 8.1 Obstacle Truss System

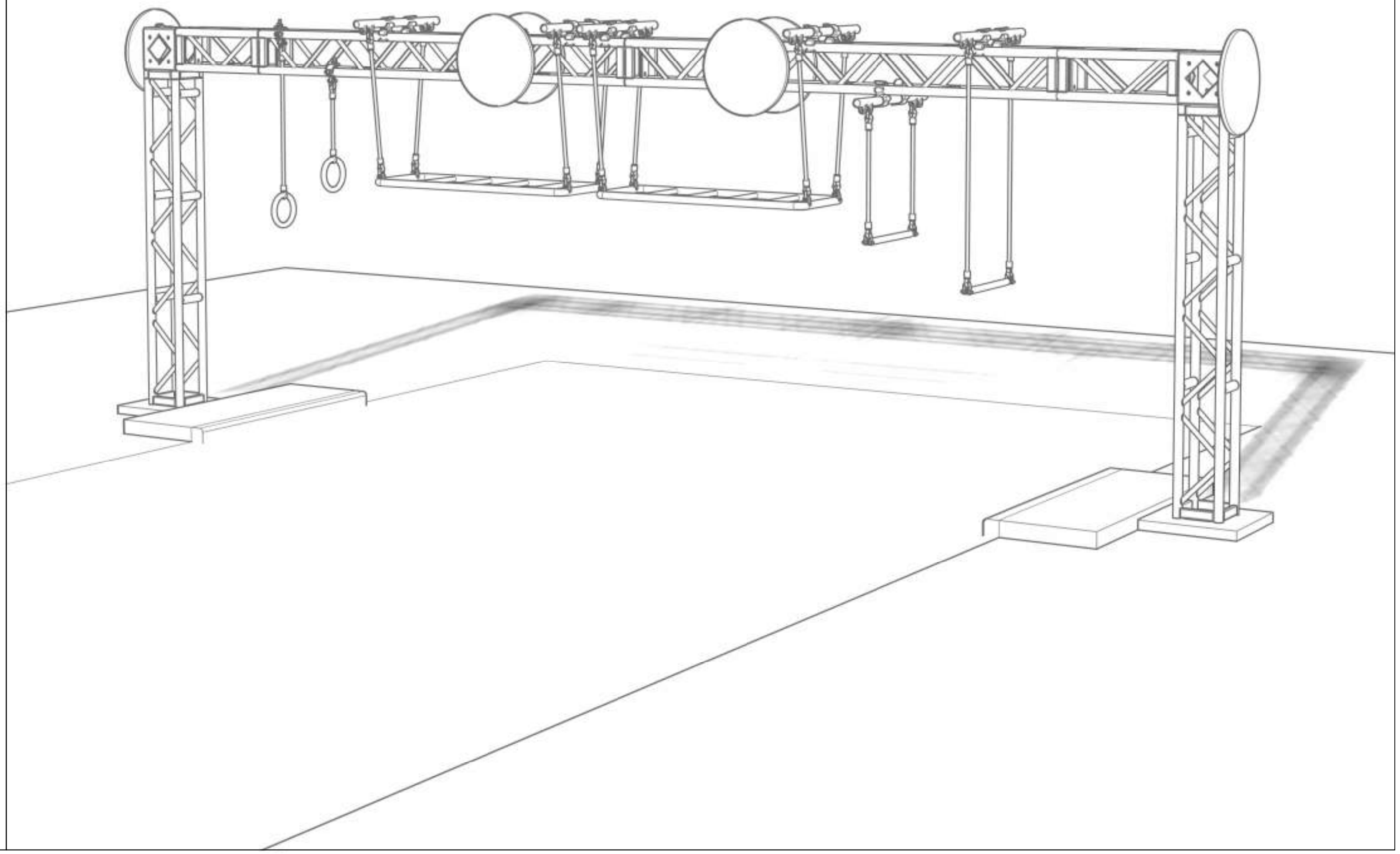
Corner Block

BASE PLATE AND ANCHOR NOTES:

FOR SLABS BETWEEN 4" AND 6" THICK:
INSTALL CUSTOM XSF BASE PLATE WITH (4) 5/8"Ø THREADED ROD ANCHORS IN AN 18" SQUARE PATTERN. EMBED 2¾" USING HILTI HIT-RE 500 V3 ADHESIVE.

FOR SLABS 6" THICK OR GREATER:
ANCHOR TRUSS DIRECTLY DOWN TO SLAB WITH (4) 5/8"Ø THREADED RODS AND HILTI HIT-RE 500 V3 ADHESIVE. USE A MINIMUM 4½" EMBEDMENT.

CONCRETE COMPRESSION STRENGTH SHALL BE 4000 PSI OR GREATER IN ALL CASES.



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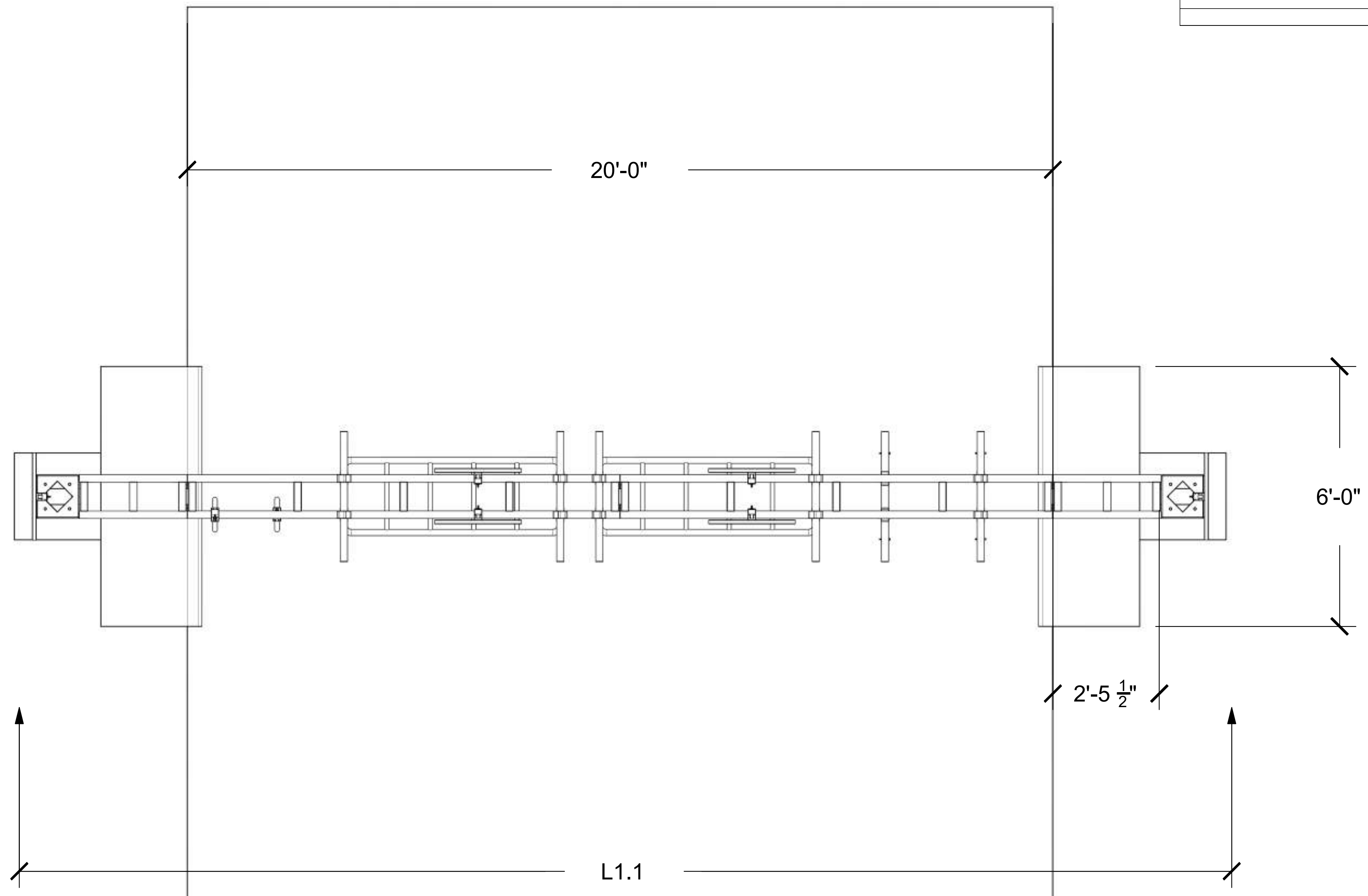

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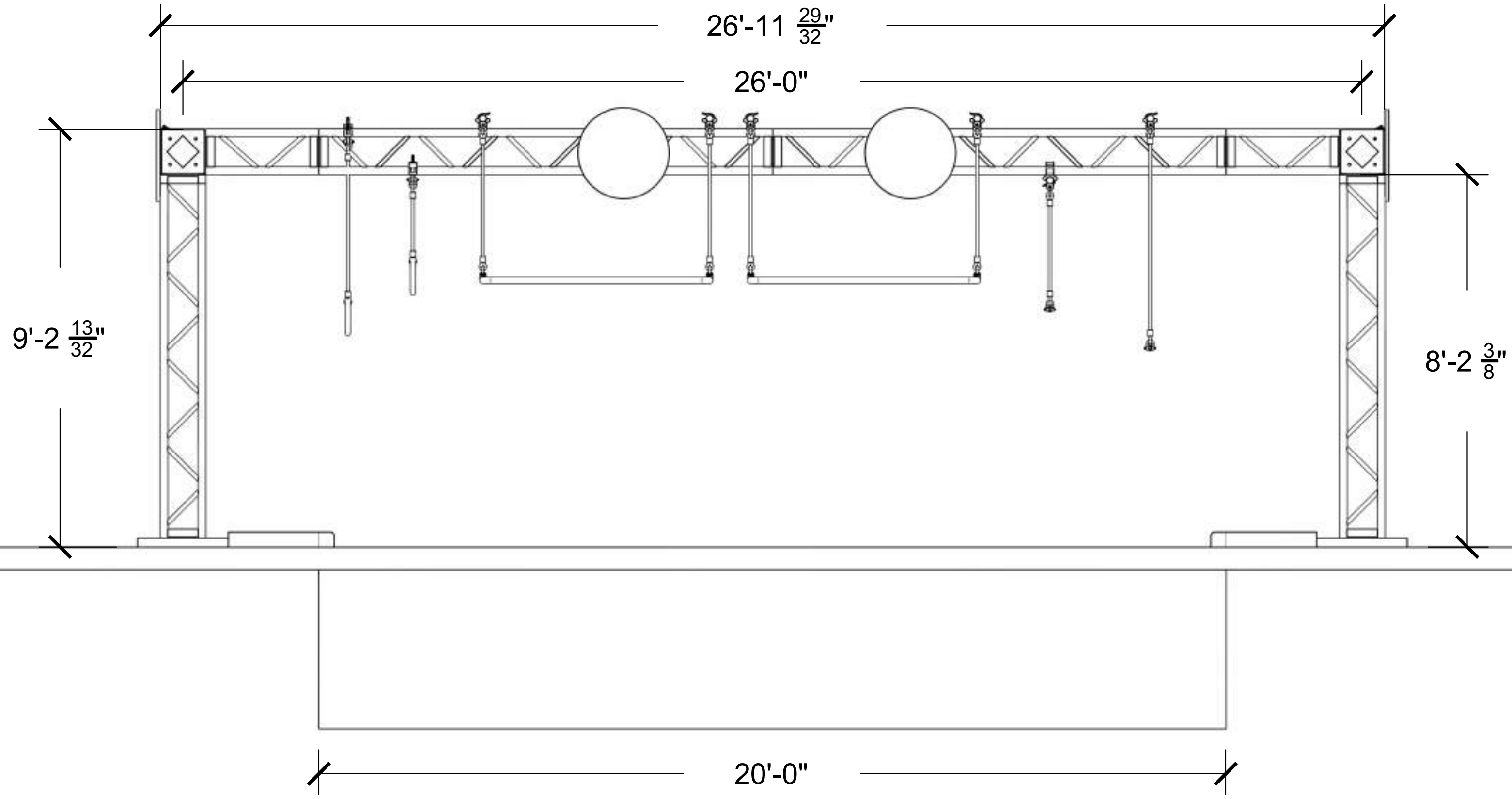

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Disclaimers and Important Manufacturer Information

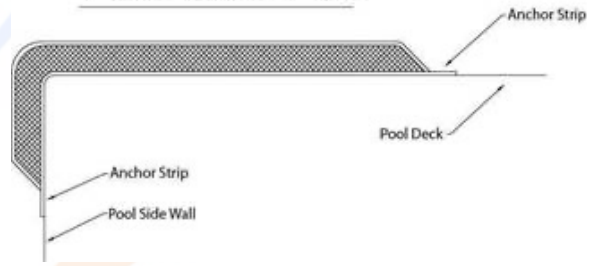
•The NinjaCross MiniNinja System & ancillary components require installation by qualified personnel. Use of non-qualified trades' people or use of non-approved parts will void the manufacturer's Warranty.

• NinjaCross MiniNinja maintenance is the responsibility of the owner. It is recommended a maintenance log be kept documenting water quality including all performed maintenance. See suggested inspection check lists, water quality log, and maintenance section for guidelines on how to maintain the system, in addition to keeping your Warranty valid. These documents may be called on if warranty issues arise.

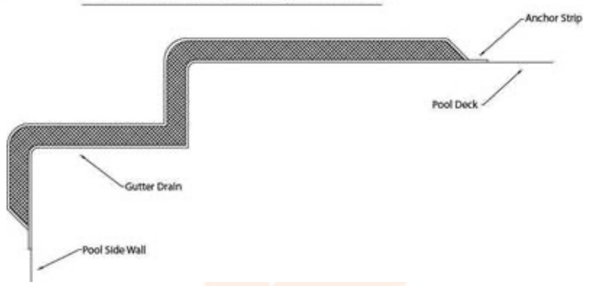
•When receiving manufacturer shipments, inspect all items for damage and quantity immediately. Failure to do so could result in costly repair or replacement costs at the expense of the owner/installer. When receiving any shipments, be sure to inform the driver of any discrepancies and report as indicated on the shipping documentation when signing for receipt of goods. All claims must be reported within 48 hours of receipt of goods. Claims reported outside of this time cannot be guaranteed. If nothing has been noted on the Bill of Lading a claim may not be accepted. If you are unable to inspect the shipment at time of receipt you must note on the Bill of Lading "Subject to inspection".

•NinjaCross Systems does not supply the Safety Padding. Safety Padding is the sole responsibility of the Owner/Operator. Pool Side Pads are designed to be placed on the side of the pool to protect patrons as they enter and exit the MiniNinja area. Pads typically form an L-Shape covering the length of your area and protect the top walk area, the pool side wall and the pool edge. Pads can also be made in a "stair-step" shape to protect pool walls with drain gutters.

Pool Side Pad



Pad with Gutter Drain



WATER RECREATION VARIANCE REQUEST
CHENEY AQUATIC CENTER

Washington State Department of HEALTH

State Board of Health
October 8, 2024

Introduction

David DeLong

Water Recreation Program Lead

David.delong@doh.wa.gov

@WADeptHealth

Background - Variances

WAC 246-262-160, Variance.

The board may grant a variance from requirements of chapter **246-262** WAC if, in the sole discretion of the board, data and/or research provides **sufficient evidence** that the recreational water contact facility (attraction, device, equipment, procedure, etc.), **will adequately protect public health and safety**, as well as water quality.

The request is to vary from:

- WAC 246-262-060(5)(b)(vi) requirement for a diving envelope
- WAC 246-262-010(21) definition of a diving envelope

3 features proposed:

- Aqua climb climbing wall
- Aqua Zip'N rope swing
- Ninja cross obstacle course

Affected WAC

WAC 246-262-010(21) Definition of a Diving Envelope

"Diving envelope" means the minimum dimensions of an area within the pool necessary to provide entry from a diving board, platform, or attraction segment where users enter above pool water level.

WAC 246-262-060(5)(b)(vi) General Design, Construction, and Equipment requirements for Diving Envelopes

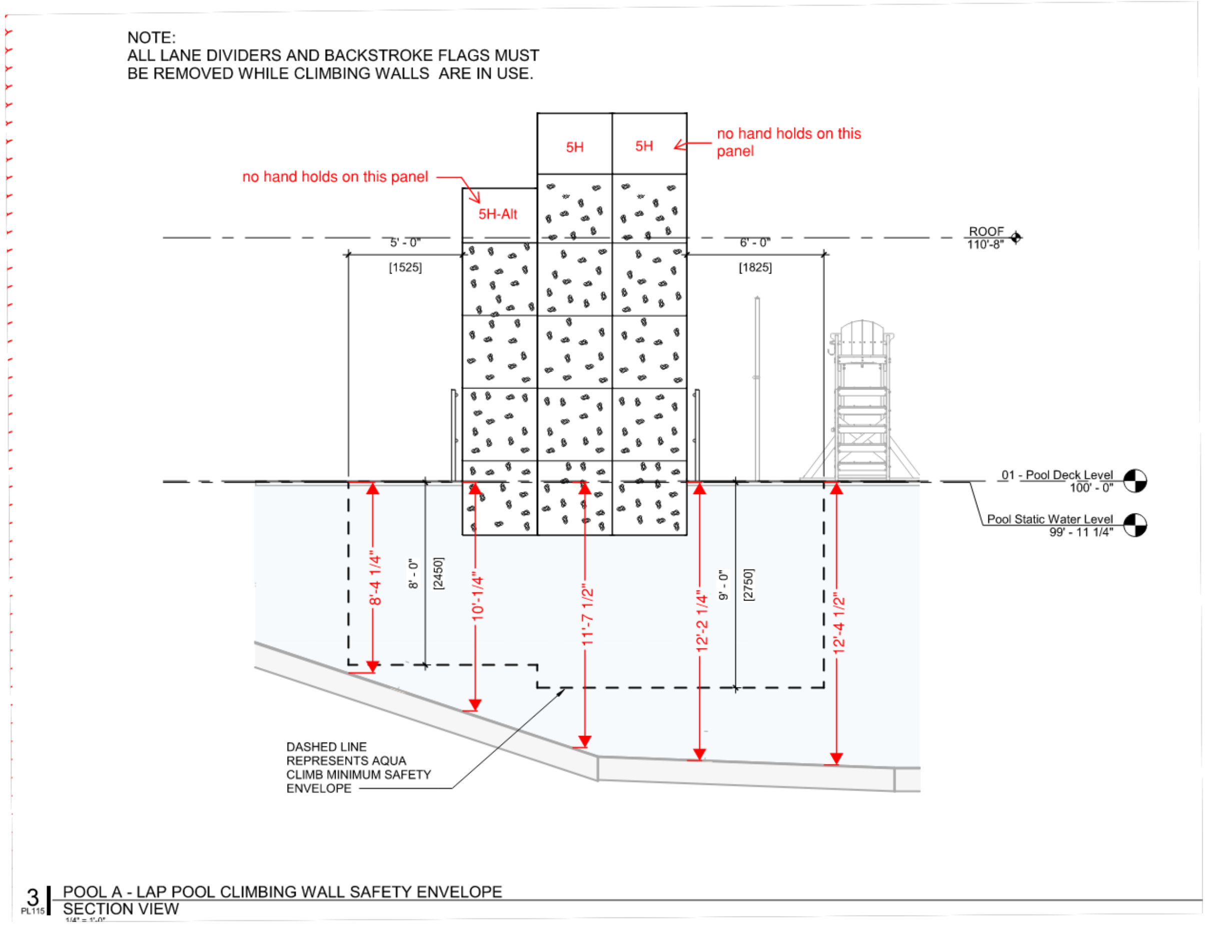
- Minimum Dimensions depending on diving deck level
- Handholds
- Ladders
- Nonslip tread
- Etc.

Aqua Climb – Installation Cheney

- This feature is a climbing wall using the 5-Alt and 5 high configurations.
- When used as expected, participants enter the water in a body orientation with the head up.
- It is designed with the expectation that participants may strike the pool bottom with their feet.
- Maximum participant velocity at recommended installation depth is 1.35 m/s.

Aqua Climb – Installation Cheney Continued

- 5-Alt climbing section
  - CG Fall height = 8.5 feet
  - depth = 10.02 feet
  - Safety envelope depth = 8 FT
  - Velocity at safety envelope = 1.35 m/s
- 5-high climbing sections
  - CG Fall Height = 9.33
  - minimum depth = 10.90 feet
  - Safety envelope depth = 9 FT
  - Velocity at safety envelope = 1.00 m/s
- Results are for the largest size participant.
- Participants are unlikely to contact the pool bottom at install depths.



Summary & Recommendations – Aqua Climb

We believe this installation meets the intent of providing a "diving envelope" because participants are unlikely to contact the pool bottom.

DOH and Spokane Regional Health District recommend that the Board approve this variance request with conditions:

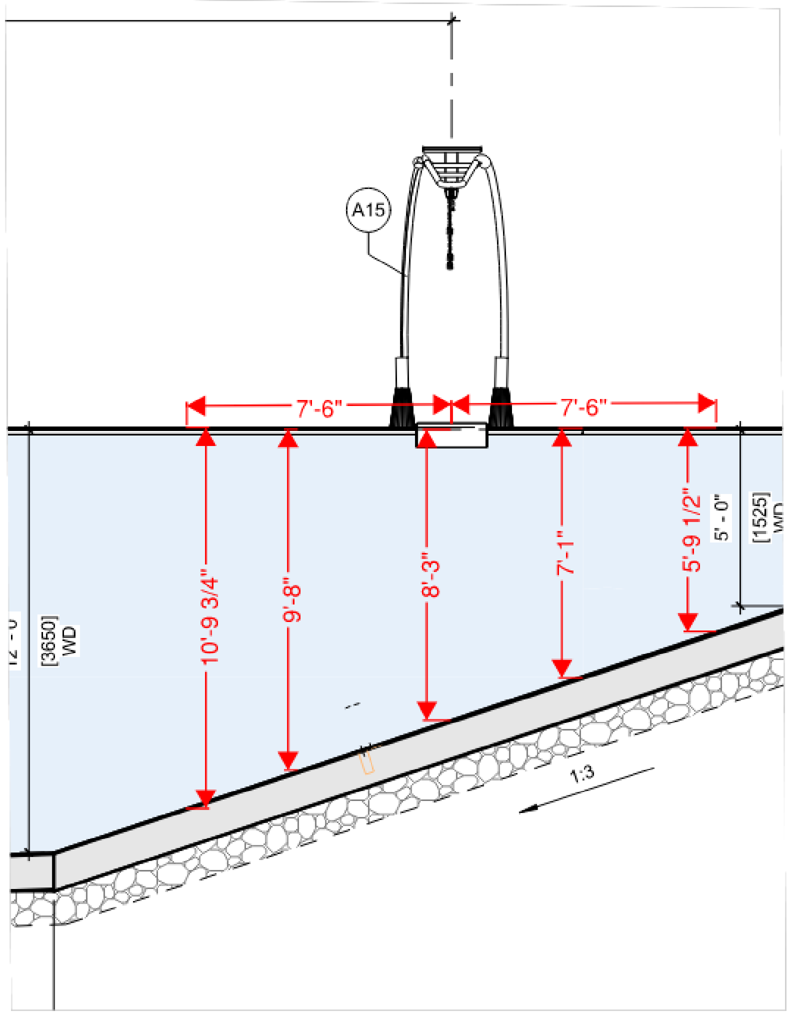
1. All manufacturer installation, maintenance, and use guidelines must be followed.
2. The Aqua Climb must be installed as shown on submitted plans with a minimum water depth of 10 ft. under the 5-alt climbing panels, and a minimum water depth of 11 feet under the 5-high climbing panels.
3. Detailed rules signs must be provided, including the minimum and maximum user height and weight.
4. Only one user may be permitted to occupy the Aqua Climb at one time.
5. A dedicated lifeguard must be provided for the Aqua Climb climbing wall. The lifeguard must control the entry and exit of users.
6. The Aqua Climb climbing wall must be inspected daily and any identified maintenance issues must be addressed prior to opening the wall to users.
7. Lifeguard and operations plans must be developed and submitted to the local health jurisdiction prior to the issuance of a pool operating permit.
8. SRHD also recommended that only the Krystal clear version be used to promote visibility through the climbing wall structure.

Aqua Zip'N – Installation Cheney

- This feature is a rope swing/zipline.
- When used as expected, participants enter the water in a body orientation with the head up.
- It is anticipated that participants have the potential to strike the pool bottom with their feet when installed using the manufacture's recommended minimum water depth.

Aqua Zip'N – Installation Cheney Continued

- Maximum handhold height = 87"
- Expected maximum fall = 2.43 ft
- Maximum depth penetration = 5.76 ft
- Maximum participant = 6 ft / 250 lbs



Summary & Recommendations – Aqua Zip'N

We believe this installation meets the intent of providing a "diving envelope" because participants are unlikely to contact the pool bottom.

DOH and Spokane Regional Health District recommend that the Board approve this variance request with conditions:

1. All manufacturer installation, maintenance, and use guidelines must be followed.
2. The Aqua Zip'N must be installed as shown on submitted plans with a minimum water depth of 8ft. under the center of the Aqua Zip'N device.
3. Detailed rules signs must be provided, including the minimum and maximum user height and weight.
4. Only one user may be permitted at one time.
5. A dedicated lifeguard must be provided for the Aqua Zip'N. The lifeguard must control the entry and exit of users.
6. The Aqua Zip'N must be inspected daily and any identified maintenance issues must be addressed prior to opening the wall to users.
7. Lifeguard and operations plans must be developed and submitted to the local health jurisdiction prior to the issuance of a pool operating permit.

Ninja Cross – Installation Cheney

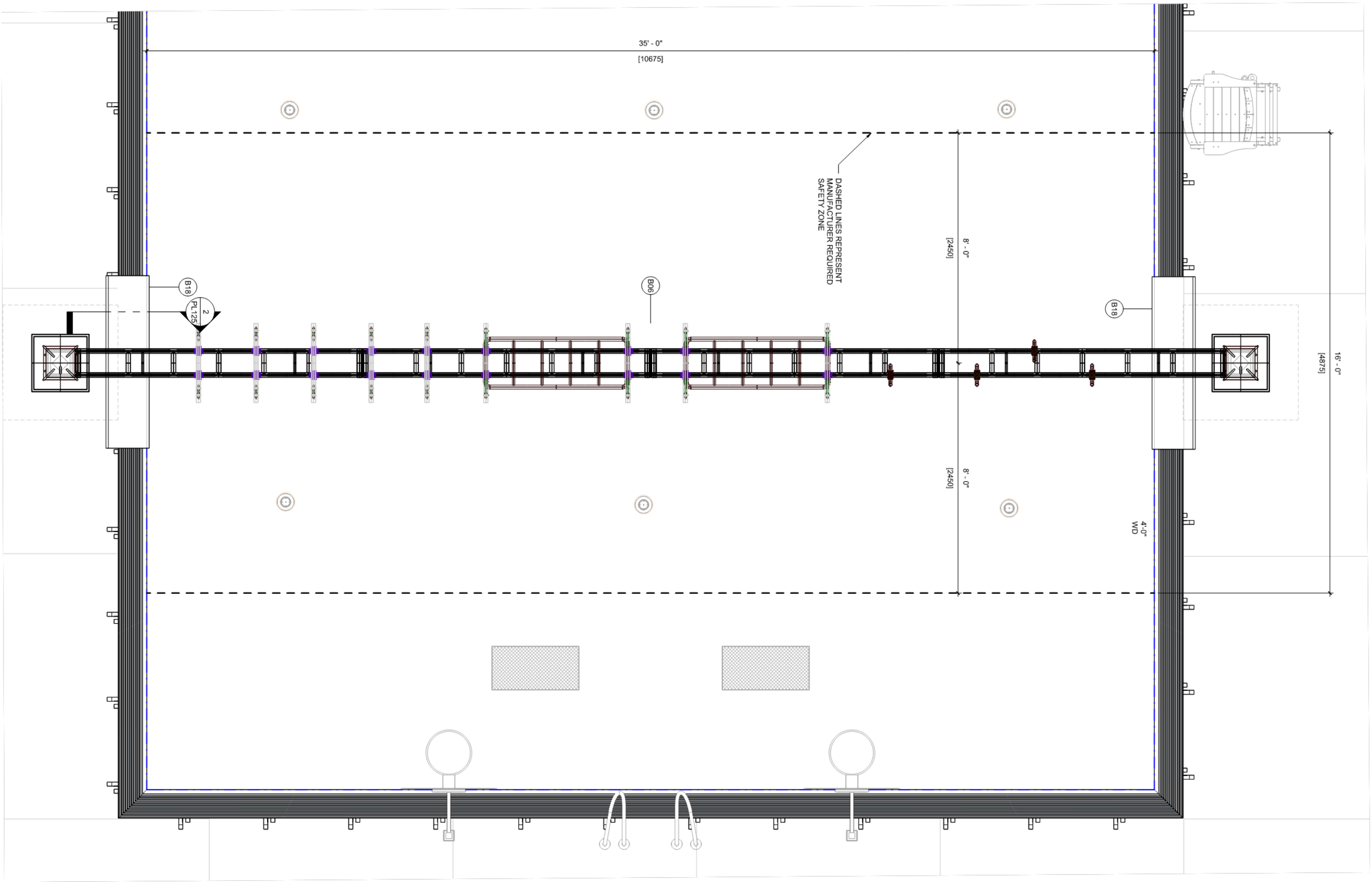
- This feature is an obstacle course with challenge elements suspended above the water.

- When used as expected, participants have part of their body in or touching the water.

- To ensure a “worst case scenario”, the engineering study assumed that participants begin their drop 20 inches above the water surface.

Ninja Cross – Installation Cheney Continued

- Pool water depth = 3.58 ft to 4.0 ft
- Manufacture specified safe water depth = 3.5 ft
- Calculated impact velocity for maximum participant = 1.41 m/s



Ninja Cross - Evaluation

- Part of body in the water.
- Participants are expected to hit bottom.
- Maximum velocity on contact is 1.4 m/s.
- A variance may not be required because this feature is designed to have the user enter at or below water level.

Summary & Recommendations - Ninja Cross

WAC 246-262-010(21) - "Diving envelope" means the minimum dimensions of an area within the pool necessary to provide entry from a diving board, platform, or attraction segment where users enter above pool water level.

DOH determined after review of the Ninja Cross specifications that, since the starting position of the user is partially in the water, and not above pool water level, diving requirements do not apply, and this item may not need a variance. In addition, the velocity of participants when they contact the pool bottom is similar to the velocity of a “step-in” pool entry from the deck.

DOH recommends that the Board determine that installation of a Ninja Cross as specified complies with the rules and does not require a variance.

Safety Calculations

NinjaCross System Design Participant Results				
	Vertical Drop	Diagonal Drop	Tucked Knee Drop	Horizontal Drop
Velocity at Pool Bottom	2.9 mph	2.9 mph	1.8 mph	0.0 mph
Effective Height of Drop	3.4 in	3.4 in	1.3 in	0.0 in

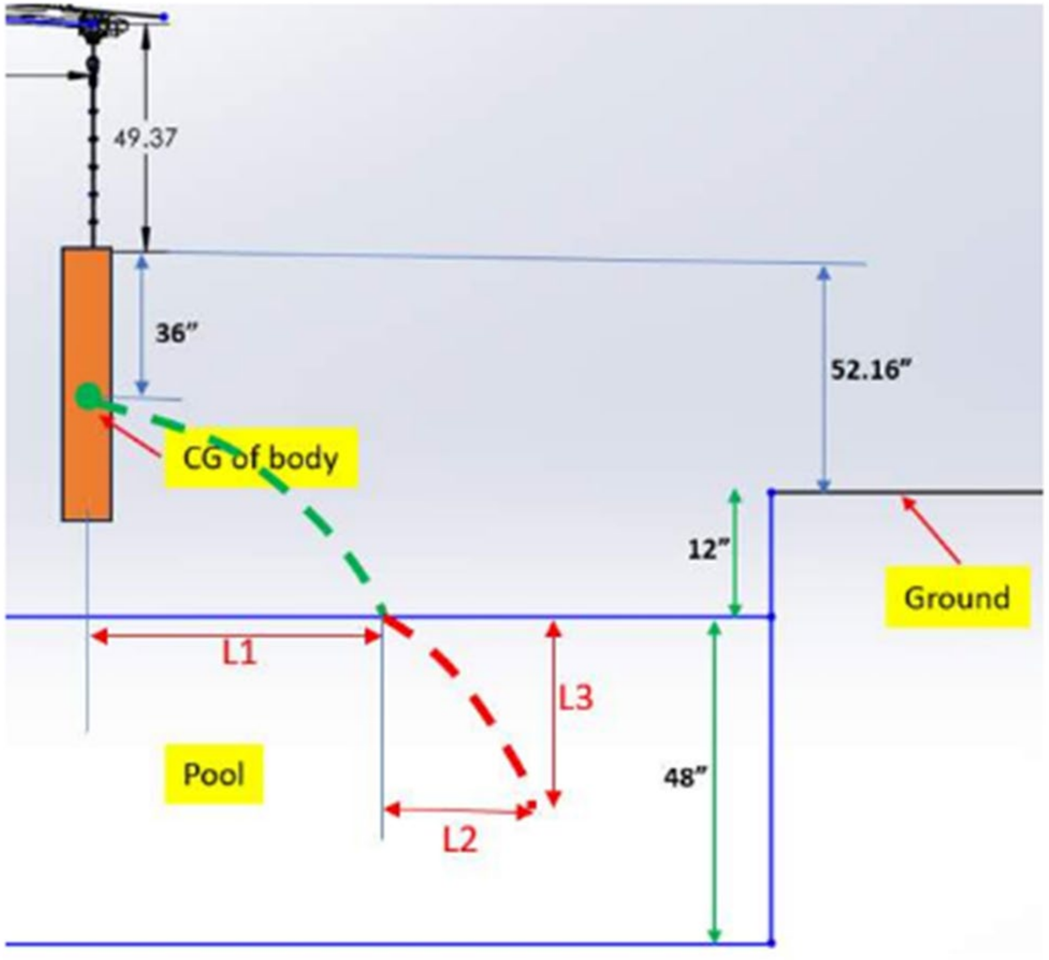
Aqua Climb Results for the largest participant

Model	Plummet Height (S_1)	Water Depth (S)	Calculated velocity at pool floor (V_2)	Benchmark velocity
3H	S_1 = 35" = 0.89m	S = 6' = 1.829m	0.84 m/s	2.99 m/s
3H Alt	S_1 = 25" = 0.64m	S = 5' = 1.524m	0.90 m/s	2.99 m/s
4H	S_1 = 73" = 1.85m	S = 7' = 2.134m	1.35 m/s	2.99 m/s
4H Alt	S_1 = 63" = 1.60m	S = 6' = 1.829m	1.63 m/s	2.99 m/s
5H	S_1 = 112" = 2.84m	S = 9' = 2.743m	1.00 m/s	2.99 m/s
5H Alt	S_1 = 102" = 2.59m	S = 8' = 2.438m	1.35 m/s	2.99 m/s

Safety Calculations Continued

Calculation Results:

- Before touching the water, the body can move in horizontal direction L1 = 4.75 ft
- The max moving distance in horizontal direction in the water is about L2 = 2.76 ft
- The max depth in the water is about L3 = 2.76 ft.
- Note: If counting the body height 6ft, the max depth in the water would be 5.76 ft



Washington State Department of HEALTH

THANK YOU!

WASHINGTON STATE BOARD OF HEALTH

Date: October 8, 2024

To: Washington State Board of Health Members

From: Patty Hayes, Board Chair

Subject: Variance Request (Yakima) –WAC 246-262-060(5)(b)(vi), Diving Envelope Requirements

Background and Summary:

RCW 70.90.120 authorizes the State Board of Health (Board) to adopt rules governing safety, sanitation, and water quality of water recreation facilities. WAC 246-262-160 sets the process for variance requests. The Board has the sole discretion to approve variance requests, if the Board determines the data and research provides sufficient evidence that the variance will adequately protect public health and safety.

On June 21, 2024, the Board received a variance request from Brooke Hanley of NAC Architecture requesting a variance approval of three separate pieces of equipment as they relate to diving envelope requirements, as defined in WAC 246-262-010(21), definition of diving envelope, and as regulated under WAC 246-262-060(5)(vi). The equipment includes a NinjaCross Obstacle Course, AquaZip'n Rope Swing, and a climbing wall.

On August 7, 2024, Board and Department of Health staff introduced the variance requests to the Board. Due to the large size of supporting documentation, staff needed additional time to complete the review and consider whether a variance would adequately protect public health and safety in order to provide the Board with complete information for their determination.

Staff has completed a review of the variance requests. Board Policy Advisor Shay Bauman will introduce the topic and set expectations for reviewing the materials. Dave DeLong with the Department of Health will present the Board with additional engineering information related to the requests and recommendations.

Recommended Board Actions

The Board may wish to consider and amend, if necessary, the following motions:

Aquaclimb

The Board moves to grant a variance to WAC 246-262-060(5)(b)(vi), diving envelope requirements, to install a climbing wall as specified by the variance request at the Aquatic Center at MLK Jr. Park, subject to the conditions recommended by the Department of Health.

OR

The Board moves to deny the variance request to WAC 246-262-060(5)(b)(vi), diving envelope requirements to install a climbing wall, as specified by the variance request, at the Aquatic Center at MLK Jr. Park.

AquaZip'N Rope Swing

The Board moves to grant a variance to WAC 246-262-060(5)(b)(vi), diving envelope requirements, to install an AquaZip'N Rope Swing as specified in the variance request at the Aquatic Center at MLK Jr. Park, subject to the conditions recommended by the Department of Health.

OR

The Board moves to deny the variance request to WAC 246-262-060(5)(b)(vi), diving envelope requirements to install an AquaZip'N Rope Swing as specified in the variance request at the Aquatic Center at MLK Jr. Park.

Ninja Cross

The Board determines that the installation of a Ninja Cross obstacle course as specified in the variance request does not require a diving envelope and therefore does not require a variance for installation.

OR

The Board moves to grant a variance to WAC 246-262-060(5)(b)(vi), diving envelope requirements, to install a Ninja Cross obstacle course as specified in the variance request at the Aquatic Center at MLK Jr. Park, subject to the conditions recommended by the Department of Health.

OR

The Board moves to deny the variance request to WAC 246-262-060(5)(b)(vi), diving envelope requirements to install a Ninja Cross obstacle course as specified in the variance request at the Aquatic Center at MLK Jr. Park.

Staff
Shay Bauman, Policy Advisor

Patty Hayes, Board Chair
Washington State Board of Health
PO Box 47990
Olympia, WA 98504-7990

AQUATIC CENTER at MLK JR. PARK, Yakima

Variance Letter D ate: 2024.06.20

STATE IDENTIFICATION: State ID Facility #: F0476 Project #:2024003

Facility Information:
Aquatic Center at MLK Jr. Park (New outdoor pool facility with 5,300sf pool building and two leisure pools)
Plan Submittal: Drawing Plans have been submitted for review.

Aquatic Center at MLK Jr. Park, City of Yakima

Owner Contact:	Ken Wilkinson	Phone: 509-576-6416
Owner Address:	129 N 2nd street	Yakima, WA 98901
Facility Address:	610 S 9th Street	Yakima, WA 98901
Owner Representative:	Brooke Hanley (NAC Architecture) 509-838-8240	

Variance Request Contact:
NAC Architecture: Brooke Hanley Phone: 509-838-8240 Email: bhanley@nacarchitecture.com

Variance Request Citation:
WAC 246-262-160 states *the board may grant a variance from requirements of chapter* ***246-262*** *WAC if, in the sole discretion of the board, data and/or research provides sufficient evidence that the RWCF (attraction, device, equipment, procedure, etc.), will adequately protect public health and safety, as well as water quality.*

Variance Request: Code Related to Diving Envelope (WAC 246-262-010(21) & WAC 246-262-060(5)(vi)) for a **climbing wall** attraction.

Items noted in review letter include:

- **Climbing wall** attraction receiving pool shall meet the 2000-2001 FINA facility rules (depth application and setbacks)

In the Department of Health review response letter issued by Justin Law dated May 22, 2024, Justin requests NAC Architecture (NAC) and WaterTechnology, Inc. (WTI) to address important concerns regarding public safety related to the receiving pool for the proposed **climbing wall** attraction in Pool B. The concern is to address the minimum depth of the pool to be compliant with the WAC 246-262-010(21) & WAC 246-262-060(5)(c)(vi) regarding diving envelopes for features where users enter the water at 20" or higher above the water surface.

On behalf of the City of Yakima, WA; NAC & WTI respectfully requests your consideration of the current pool depth design at the climbing wall for the future Aquatic Center at MLK Jr. Park. To support this request we provide the attached information, engineering exhibits, and following commentary:

- The review letter states that the "diving envelope" from WAC 246-262-010(21) applies to **all attractions** where users enter above pool water level and therefore requires the CNCA (enter less than 20" above the water surface) or FINA (enter 20" or greater above the water surface) water depths. We submit that the attached engineering calculations for the **AquaClimb 3-Panel-High climbing wall** product will demonstrate that the manufacturer's required water depths and the designed water depths provided at the Yakima Aquatic Center are sufficient to protect the safety of the range of users allowed to participate in this attraction. Calculations were completed for a 48" tall, 50lbs person and a 78" tall, 250lbs person to show a range of sizes requested in the review letter. Please reference page 9 for the manufacturer's minimum depth requirements and pages 10-17 for the engineering calculations and associated notes. The Yakima design provides for 6" greater water depth than the minimum required by this engineering report. Please review the attached data in support of using the manufacturer's depth requirements in lieu of the CNCA or FINA diving envelope dimensions.

- WAC 246-262-060(5)(c)(vi) appears to apply specifically to "diving envelopes in pools or areas of pools designated for diving activities". The applicant submits that diving activities are generally defined as plunging into the water headfirst. Diving headfirst into water results in the need for deeper water to avoid a head & neck collision with the bottom of the pool which is different than a feet-first or tucked entry plunge where the body is significantly slowed in the first two feet of water. The **climbing wall** safety guidelines and standard operating procedures (provided in the exhibits) will note that users are required to re-enter the water in a feet-first manner. Diving from the unit is prohibited (and per the manufacturer data, bio-mechanically impossible). The engineering calculations completed also assumes a feet-first plummet into the water.

- The Model Aquatic Health Code also addresses the complexity of "other aquatic features" like **climbing walls** and would suggest that the manufacturer recommendations for design and operation would be adequate to install the feature.

  4.12.10A Other Aquatic Features Other AQUATIC FEATURES not otherwise addressed in the CODE, including but not limited to climbing walls, inflatables, and play structures, shall not be installed unless designed and operated in accordance with all manufacturer's installation and operations recommendations.

- 'A-frame' signs with all written safety guidelines will be publicly displayed near the **climbing wall** (see page 18 for example) to meet the criteria of WAC 246-262-070(10). The design team could also instruct AquaClimb to add a maximum height of 78" to the sign to correspond to the engineering calculations, if this would mitigate concerns over swimmers participating that do not fit within the engineering assumptions.

- See attached climbing wall diagram. The frame and panels of the wall tilt out over the water, ensuring the swimmer's descent is away from the wall and pool edge. The protective panels at the top do not have hand-holds and therefore prevents climbing over the top of the structure.

- This pool will be lifeguarded at all times while in operation and the lifeguard staff will be the first line of defense to screen bathers to make sure they are experienced swimmers, instruct swimmers on proper use of the attraction, and direct proper swimmer circulation to and from the activity within the pool to avoid congestion or collisions. The **climbing wall** will have a dedicated lifeguard to closely supervise the safety of swimmers when the attraction is open for use.

- Injury statistics requested by the review letter are not available from the manufacturer or another source, but the product literature, research paper, and testing tout the relative safety of the **climbing wall** compared to diving boards and slides. They also have over 1,000 installations across the world. See the provided letter from Aquatic Safety Research Group.

- The **AquaClimb** has also been designed and engineered to meet the following standards:
    - ASTM F24/F2291-21 Standard Practice for Design of Amusement Rides and Devices
    - ASTM F2461-20 Aquatic Play Equipment
    - European Standards EN17164 – Climbing walls for use in the water area
    - IBC 2018 & AISC Manual of Steel Construction
    - Other industry standards listed in the product data attached

- The City of Yakima specifically requested a pool design that would have a variety of intriguing activities for their patrons but would not need water deeper than 6-7ft. Pools deeper than 6-7ft come with their own safety risks and lifeguarding challenges. Shallow water is easier to supervise and guard. Rescues are much more likely to be needed in deep water where a bather in trouble cannot push off the bottom of the pool to bob back above the surface quickly until the lifeguard can assist them. Yakima is dedicated to making this facility fun while also as safe as possible for their community members and patrons.

- NAC submits that the design as described above and substantiated in the attached documentation meets the intent of providing a safe receiving pool for the **climbing wall** feature. NAC, WTI, and the City of Yakima respectfully requests a variance accordingly. If the State Board of Health has any follow-up conditions or actions required of the owner/operator, we are committed to implementing them.

NAC Architecture (NAC) has teamed with Water Technology (WTI) on numerous aquatic projects and so we have a history of producing these projects successfully. WTI has been designing Aquatic venues for over 40 years. WTI is widely known in the industry as one of the leading aquatic design firms in North America. As one of the industry's leaders, WTI has represented the waterpark industry during CPSC meetings on review of VGB rules and has also been involved in reviewing/editing sections of the MAHC.

They are also represented in the Washington DOH committee to update the existing administrative code to adopt a more comprehensive aquatic code like the MAHC. The NAC and WTI commitment to safe aquatic facilities is proven. The design of the receiving pool at the **climbing wall** for the Yakima Aquatic Center will not put the health and safety of the public at risk. The City of Yakima, having operated a public pool for many years is experienced and committed to the safety and the welfare of their patrons.

On behalf of the City of Yakima, NAC Architecture would like to thank you for your consideration of this Variance Request. Please feel free to contact me with any questions you may have regarding this request.

Thank you,

Brooke Hanley

Brooke Hanley, AIA, Principal Architect, NAC Architecture

<u>Attachments</u>:

- AquaClimb Safety and Fall Zone Engineering, including a floor plan and section of the receiving pool as designed for the Yakima Aquatic Center.

REV.NO.	DESCRIPTION	DATE
1	CHANGE PROPOSAL	04/16/2024

CONFORMED SET

POOL B-ACTIVITY DATA

DESCRIPTION	QTY	UNITS	
POOL PERIMETER	314'-0"	FEET	
WATER SURFACE AREA	3,832	SQUARE FEET	
POOL WATER TEMPERATURE	84	°F	
POOL VOLUME	136,514	GALLONS	
SURGE TANK OPERATING VOLUME	7,415	GALLONS	
TOTAL VOLUME OF WATER	147,268	GALLONS	
CIRCULATION RATE	1,033	GPM	
TURNOVER/VOLUME/FLOW	60 MIN.	19,330 GAL.	322 GPM
TURNOVER/VOLUME/FLOW	180 MIN.	127,938 GAL.	711 GPM
FILTRATION RATE	12.66	GPM/FT²	
BACKWASH FLOW	306	GPM	
SURGE FACTOR	1.06	GAL/SQFT	
AVAILABLE SURGE CAPACITY IN SURGE TANK	4075	GALLONS	

SCHEDULE - BASIS OF DESIGN - POOL B

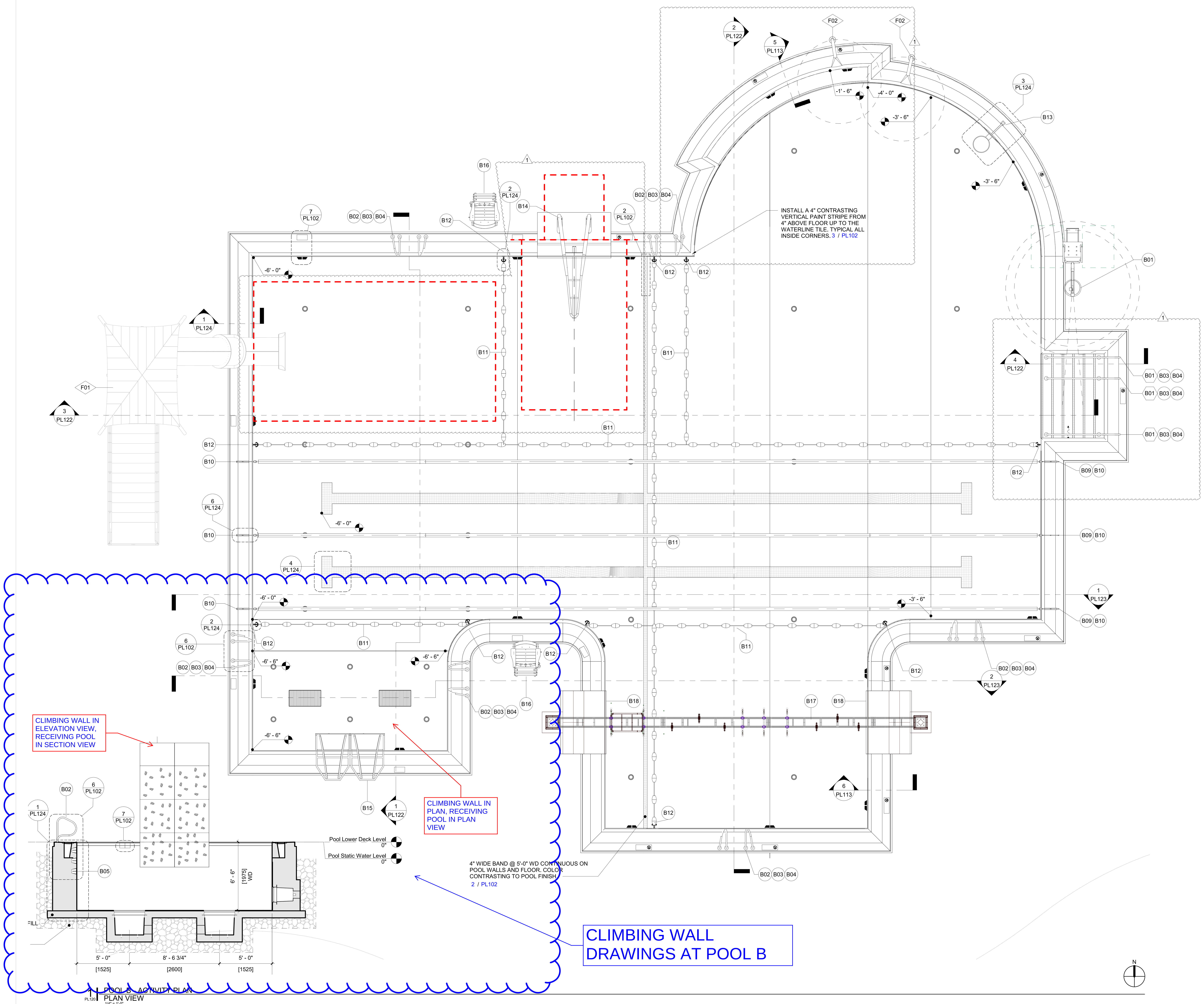
POOL ID	EQUIPMENT ID	EQUIPMENT	QTY	MANUFACTURER	DESCRIPTION
B	01	POOL LIFT	1	SR SMITH, AQUA CREEK, OR EQUAL	STANDARD ANCHORED, ROTATIONAL POOL LIFT, WITH 400 LB MINIMUM LIFTING CAPACITY. MUST MEET ALL APPLICABLE ADA REQUIREMENTS, WHILE MAINTAINING REQUIRED DECK CLEARANCE. PACKAGE TO INCLUDE ARMRESTS, ANCHOR, LIFT COVER, BATTERY CHARGER, AND CADDY
B	02	GRAB RAILS (PAIRS)	6	PARAGON AQUATICS, SPECTRUM AQUATICS, SR SMITH OR EQUAL	PRETZEL BEND STYLE, 1.50" OD x .120 WALL THICKNESS, 500 GRIT FINISH MIN.
B	03	ESCUTCHEON PLATE	34	PARAGON AQUATICS, SPECTRUM AQUATICS, SR SMITH OR EQUAL	STAINLESS STEEL ROUND ESCUTCHEON FOR 1.50" O.D. RAILS
B	04	WEDGE ANCHOR	34	PARAGON AQUATICS, SPECTRUM AQUATICS, SR SMITH OR EQUAL	CAST BRONZE, 4-1/4" LONG, ACCEPTS 1.500" OD TUBING
B	05	IN-WALL STEPS	18	PARAGON AQUATICS, SPECTRUM AQUATICS, SR SMITH OR EQUAL	17-1/2" x 6", INJECTION MOLDED PLASTIC, PEBBLE TEXTURE, 1/4" WALL THICKNESS
B	09	LANE DIVIDERS	3	COMPETITOR SWIM PRODUCTS	4" WAVE QUELLING RACING LANE LINE, COLORS BY OWNER / ARCHITECT
B	10	DalFLEX LANE LINE ANCHOR	6	DALDORADO	12" – NON-CORROSIVE PVC FLIP UP LANE LINE ANCHOR TO BE USED WITH DALDORADO PARALLEL GRATING. INCLUDES FLIP-UP HATCH, BASE UNIT, & SILICON COVERED SS BRAIDED STRAP EXTENSION WITH HOOK. CAN BE USED WITH THE DalFLEX 8" OR 14" LANE LINE EXTENSION.
B	11	SAFETY ROPE	6	PARAGON AQUATICS	3/4" POLYETHYLENE ROPE WITH 5"x9" HANDI-LOCK FLOAT, VERIFY LENGTH WITH PLANS
B	12	CUP ANCHOR	10	PARAGON AQUATICS, SPECTRUM AQUATICS, SR SMITH OR EQUAL	4" SQUARE 304L SS ANCHOR AND 304L SS EYE BOLT
B	13	BASKETBALL HOOP	1	SR SMITH	STAINLESS STEEL BASKETBALL HOOP WITH ROCKSOLID ANCHOR
B	14	AQUA ZIPN	1	AQUACLIMB	DECK-MOUNTED OVERHEAD ROPE SWING, WITH SELF-RETRACTING TROLLEY, POWDER-COATED STAINLESS STEEL WITH HIGH TENACITY POLYESTER ROPE. INCLUDES SAFETY PAD-UNIVERSAL, WITH 316 SS HILTI FLUSH MOUNT CONCRETE ANCHORS.
B	15	AQUACLIMB	1	AQUACLIMB	2 WIDE X 3 HIGH AQUATIC CLIMBING WALL
B	16	LIFEGUARD CHAIR	2	TAILWIND, KEIFER, SPECTRUM AQUATICS, SR SMITH OR APPROVED EQUAL	RECYCLED PLASTIC WITH 304 SS HARDWARE, COLOR BY OWNER/ARCHITECT 40" SEAT HEIGHT (OWNER'S SAFETY CONSULTANT TO SPECIFY LOCATION.)
B	17	NINJACROSS	1	NINJACROSS	AQUATIC OBSTACLE COURSE
B	18	SAFETY PAD	3	PLAYTIME	WALL AND DECK SAFETY PAD AT NINJACROSS SYSTEM

SCHEDULE - CUSTOM RAILGOODS - POOL B

POOL ID	EQUIPMENT ID	EQUIPMENT	QTY	MANUFACTURER	DESCRIPTION
B	01	HAND RAIL	3	PARAGON AQUATICS, SPECTRUM AQUATICS, SR SMITH OR EQUAL	CUSTOM FABRICATED, 316L SS, 1.50" OD x .120 WALL THICKNESS, 500 GRIT FINISH MIN.
B	02	HAND RAIL	2	PARAGON AQUATICS, SPECTRUM AQUATICS, SR SMITH OR EQUAL	CUSTOM FABRICATED, 316L SS, 1.50" OD x .120 WALL THICKNESS, 500 GRIT FINISH MIN.

SCHEDULE - WATER FEATURE - POOL B

POOL ID	FEATURE ID	FEATURE	QTY	MANUFACTURER	DESCRIPTION	GPM (ea)	GPM (Total)
B	F01	DROP SLIDE	1	SPLASHTACULAR	FUTURE SLIDE PROVIDE PIPING CAPPED ONLY	500	500
B	F02	WATER SPRAY	2	WATERPLAY	PIPE DELUGE-FAN SPRAY FEATURE	60	120



1 POOL B - ACTIVITY PLAN
PLAN VIEW
1/4" = 1'-0"

CITY OF YAKIMA
YAKIMA POOL
YAKIMA WA

WTI WATER TECHNOLOGY INC.
World Leaders in Aquatic Planning, Design and Engineering
100 Park Avenue | Beaver Dam, WI 53916
t 920.887.7375

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NAC NO 111-22082
ISSUE DATE: 4/16/24
PROJECT NUMBER: 22314
DRAWN BY: T.ED
CHECKED BY: ACC

7893 REGISTERED ARCHITECT
MATTHEW W. FREEBY
STATE OF WASHINGTON
4/16/2024

POOL B - ACTIVITY POOL PLAN

PL120

Turn your pool into an ADVENTURE with AquaClimb®

For recreation centers, fitness facilities, camps, and private clubs, AquaClimb expands poolside programming with an easy addition that is safe, engaging, and fun. As the market leader, AquaClimb offers more benefits to its customers than any other climbing product:

Modular and Customizable

AquaClimb's height, width, and panel style can all be tailored to fit the size and design of your pool, with options for adding more panels at a later phase as your budget allows.

Challenging, Realistic Climbing

With 3D contoured panels, AquaClimb delivers a realistic rock-climbing experience that engages adolescents through adults to conquer the climb in different ways.

Top Safety Record

With best-in-class safety features to ensure climbers fall away from the wall, AquaClimb also has a proven performance history from 1,000 installations across the globe.

Activates the Deep End

As a safer alternative or enhancement to diving boards, AquaClimb attracts tweens and teens to those under-utilized, deep areas of a pool.

Easy to Install

Because AquaClimb is pre-assembled in the factory, no specialized skills or equipment are required for onsite installation at your facility on any pool gutter configuration.

Minimal Footprint

AquaClimb's small deck-mounted system saves clearance space and doesn't interfere with normal lap swimming. And with no water source required, it is an easy amenity to add.

AQUACLIMB® Four Unique Models

AquaClimb Krystal

- Budget-friendly and entry-level option
- Modular, flat panels in clear, blue, and green transparent tint
- Customizable up to four height options sized to pool's depth

AquaClimb 3D

- 3D contoured panels for realistic climbing available in translucent **Ice, Glacier,** or **Jade** colors, and solid painted color schemes
- Modular panels can be turned and flipped to change up the experience
- Translucent panels allow lifeguard visibility while giving privacy to the climber behind the wall

AquaClimb Kurve

- Sleek, curved frame that allows heights up to 20 feet
- 3D contoured panels available in color options of Ice or Glacier
- Translucent panels allow lifeguard visibility while giving privacy to the climber behind the wall

AquaClimb Luxe

- Completely customizable design to match your pool's aesthetics
- 3D contoured panels
- Deck mounted or Pool wall mounted

Take on the ADVENTURE with AquaClimb®

It's never been easier to add an exciting new amenity to your:

- Camp
- Country Club
- College/University
- Swim Club
- Recreation/Aquatic Facility
- Health/Fitness Center
- Military Wellness & Recreation
- Private Residence

Join thousands of other satisfied customers who love their AquaClimb:

"Our AquaClimb is spectacular. From the time we open the pool until the time we close, there is a line to make the climb. What an ingenious product and so much fun for the kids... and a few adults."

Mark Tiernan
General Manager at the Valley Country Club
Centennial, CO

"We had a great first year with the AquaClimb. Kids were constantly lined up for it, and everyone had a blast. AquaClimb was a big reason we saw a 40% increase in attendance over the last year."

Ted Davis
Southfield Parks and Recreation
Southfield, MI

To learn how you can bring the adventure of AquaClimb to your facility, contact us today:

POOLSIDE ADVENTURES™

PoolsideAdventures.com | 800.956.6692 | info@PoolsideAdventures.com

Building Courageous Kids for Life's Great Adventure

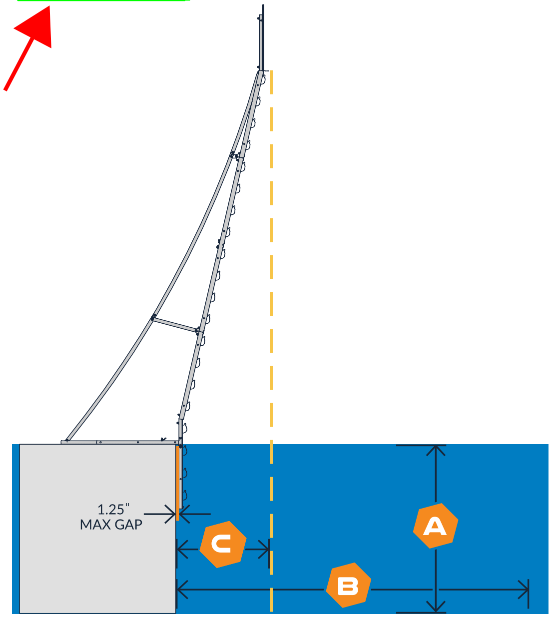
AQUACLIMB® Depth Requirements

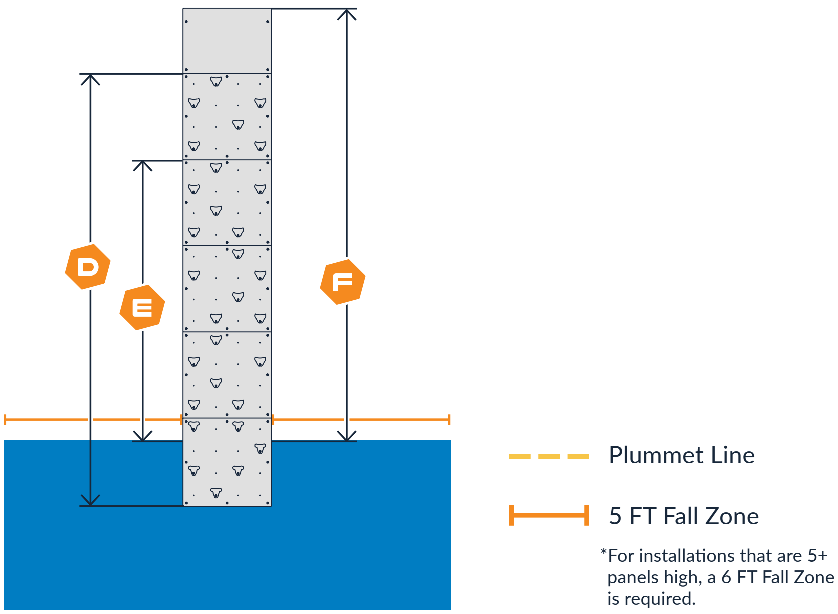
Panel Options	A Minimum Pool Depth	B Drop Zone	C Plummet line from wall	D Available climbing height	E Height of top foothold*	F Above deck wall height
3 High Alt	5'	9'	1'9"	8'10"	4'5"	9'7"
3 High Yakima Product	6'	9'	1'9"	9'10"	5'5"	9'7"
4 High Alt	6'	10'	2'6"	12'1"	7'8"	12'10"
4 High	7'	10'	2'6"	13'1"	8'8"	12'10"
5 High Alt	8'	12'	3'3"	15'5"	11'	16'1"
5 High	9'	12'	3'3"	16'5"	12'	16'1"
6 High (Kurve Only)	10'	12'	3'3"	17'	12'5"	19'8"

*Based on climber's feet positioned at least 2' below highest hand grip

Alt - Alternate configurations will have the top row of handholds plugged for non-climbing terrain to meet pool depth requirements.

Important Safety Note: AquaClimb safety distances and pool depths are based upon a climber entering the water **feet first**. The AquaClimb was designed for a feet first entry at all times and supervision must be present when the AquaClimb is in use. To ensure the maximum level of safety, **there must be no diving at any time**.





FEAmax Report

AquaClimb Hand Calculation

FEAmax LLC.

PROJECT INFO.

Change History:

Version Number	Date	Summary	Author
V 1.0	2/2/2016	Initial release	Frank Wang

Client Information:

Contact name:	Laura Grandner
Email:	Laura@aquaclimb.com
Company name:	Pyramide USA
Address:	P.O. Box 530 Frederick, MD. 21705

PROJECT DESCRIPTION

- **Project Description**

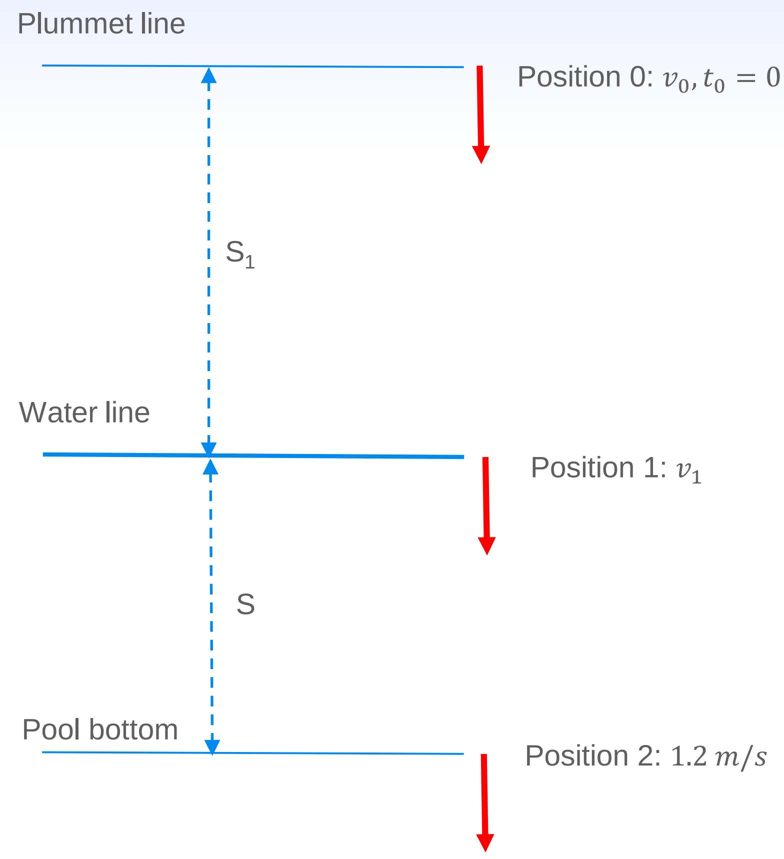
Yakima Product

1. Calculate the minimum depth required to safely plummet down from the highest foot hold point on the (4) levels of AquaClimb Walls (2H , 3H , 4H and 5H).
2. With the top climbing hold measurement provided – deduct 36" (3ft) down which would be the highest foot hold placement. Then with the following parameters calculate the minimum depth needed to safety let go and plummet straight down into the water without reaching the bottom floor of the pool.
3. Height: 48" minimum; 78" Maximum
4. Weight: 50 lbs minimum; 250 lbs maximum

CALCULATION

Assumptions:

1. Minimum height of human body H_{human}= 48” = 1.2 meter
2. Water density ρ_{water}= 1.0 g/cm^3
3. Human body density ρ_{human}= 0.9 g/cm^3
4. The velocity enter the water = V_1
5. Water Resistance coefficient C_D = 1.0
6. Human body volume = V
7. Area of human body enter the water = A
8. Velocity of human body inside the water = V_x
9. The allowable decent velocity to the pool bottom = 1.2 m/s



Force applied to human body inside water:

1. Gravity $G = \rho_{human} g V$
2. Buoyancy (floating force) $\mathrm{F} = \rho_{water} g V$
3. Water resistance force $F_{resistance} = \frac{1}{2}\rho_{water} V_x^2 A C_D$

CALCULATION

According to Newton's second law, we have:

1. The acceleration in the water: $a = \frac{dV_x}{dt} = \frac{F}{m}$
2. $a = \frac{\rho_{human} gV - \rho_{water} gV - \frac{1}{2}\rho_{water} V_x^2 AC_D}{\rho_{human} V} = \frac{0.9\times9.8\times V - 1.0\times9.8\times V - 0.5\times1.0\times V_x^2\times\frac{V}{1.2}\times1.0}{0.9\times V} = -(1.09 + 0.46V_x^2)$
3. $\frac{dV_x}{dt} = -(1.09 + 0.46V_x^2)$
4. $\mathrm{dt} = -\frac{dV_x}{(1.09+0.46V_x^2)}$
5. The max displacement of body moving in the water would be:

$$S = \int_0^t V_x \cdot dt = -\int_{1.2}^{V_1} V_x \cdot \frac{dV_x}{1.09 + 0.46V_x^2} = \cdots = -\int_{1.2}^{V_1} 0.46 \times \frac{1}{0.42} \times \frac{d(1 + 0.42 \times V_x^2)}{(1 + 0.42 \times V_x^2)}$$

$$= 1.09 \times [\,\ln(1 + 0.42 \times V_1^2) - \ln(1 + 0.42 \times 1.2^2)] = 1.09 \times [\ln(1 + 0.42 \times 2 \times 9.8 \times S_1) - 0.473]$$

6. The minimum depth of pool would be:

$$S = 1.09 \times \ln(1 + 8.23 \times S_1) - 0.52$$

CONCLUSION

If the body height is 48” (1.2 meter), we have:

$$S = 1.09 \times \ln(1 + 8.23 \times S_1) - 0.52$$

1. For 2H: S_1 = 1’ = 0.30 meter, we have the min pool depth:

   S = 0.84 meter = 2.8 feet

2. For 3H: S_1 = 1’9” = 0.53 meter, we have the min pool depth:

   S = 1.31 meter = 4.3 feet

3. For 4H: S_1 = 2’6” = 0.76 meter, we have the min pool depth:

   S = 1.64 meter = 5.4 feet

4. For 5H: S_1 = 3’3” = 1 meter, we have the min pool depth:

   S = 1.89 meter = 6.2 feet

Yakima Pool depth at climbing wall exceeds this recommendation and is 6'-6" deep

Standard Height Options	Distance of plummet line from pool wall A	Minimum pool depth required B
2H	1'	4'
3H-5'	1' 9"	5'
3H	1' 9"	6'
4H-8'	2' 6"	8'
4H	2' 6"	9'
5H-11'	3' 3"	11'
5H	3' 3"	12'

Yakima Product

CONCLUSION

If the body height is 78" (1.98 meter), the equation would be:

$$S = 1.78 \times \ln(1 + 5.49 \times S_1) - 0.60$$

1. For 2H: S_1 = 1' = 0.30 meter, we have the min pool depth:

   S = 1.13 meter = 3.7 feet

2. For 3H: S_1 = 1'9" = 0.53 meter, we have the min pool depth:

   S = 1.83 meter = 6.0 feet

3. For 4H: S_1 = 2'6" = 0.76 meter, we have the min pool depth:

   S = 2.32 meter = 7.6 feet

4. For 5H: S_1 = 3'3" = 1 meter, we have the min pool depth:

   S = 2.73 meter = 8.9 feet

Yakima Pool depth at climbing wall exceeds this recommendation and is 6'-6" deep

Yakima Product

Standard Height Options	Distance of plummet line from pool wall A	Minimum pool depth required B
2H	1'	4'
3H-5'	1' 9"	5'
3H	1' 9"	6'
4H-8'	2' 6"	8'
4H	2' 6"	9'
5H-11'	3' 3"	11'
5H	3' 3"	12'

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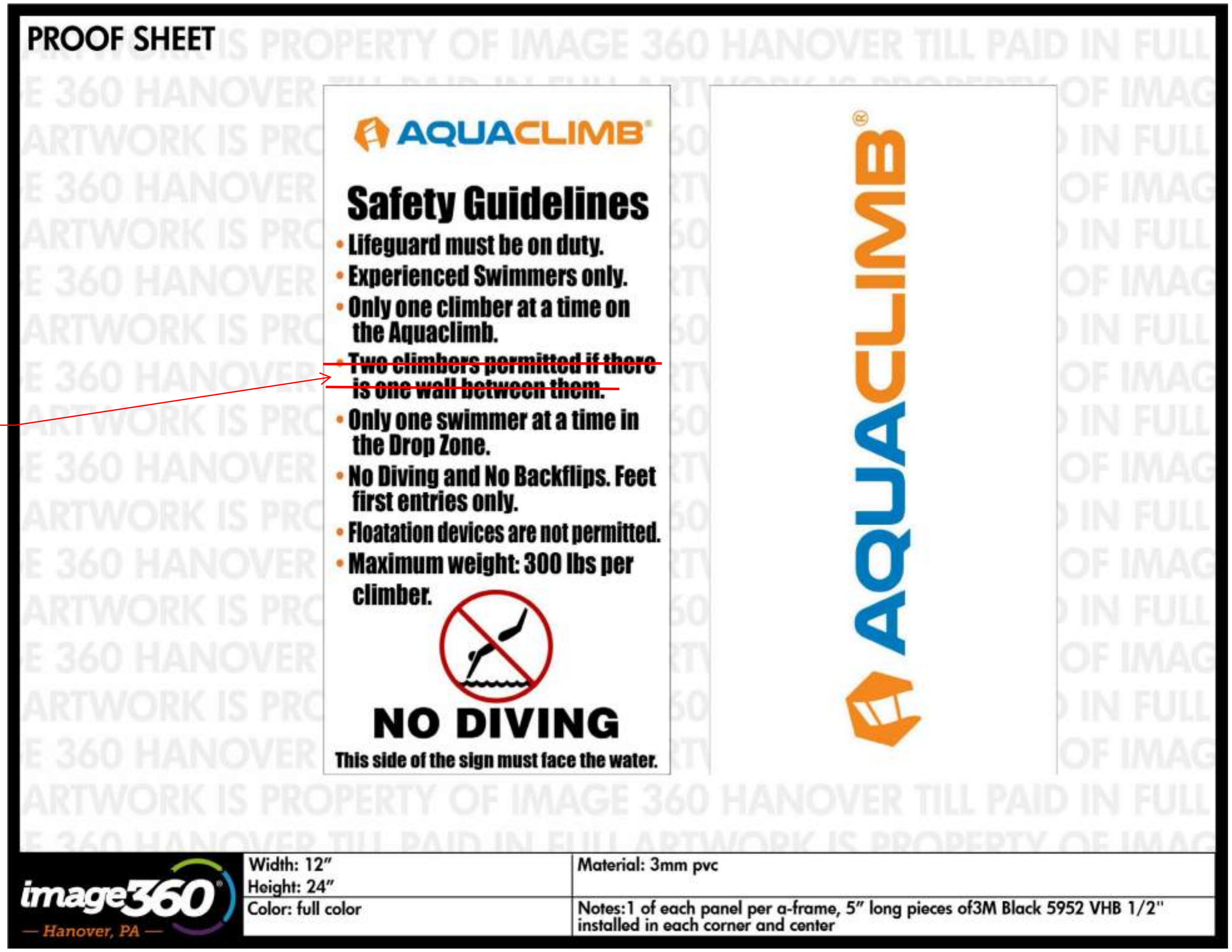
View proof for Printed PVC Panels for A-Frame

This rule does not apply to Yakima project since it is only 2 panels wide

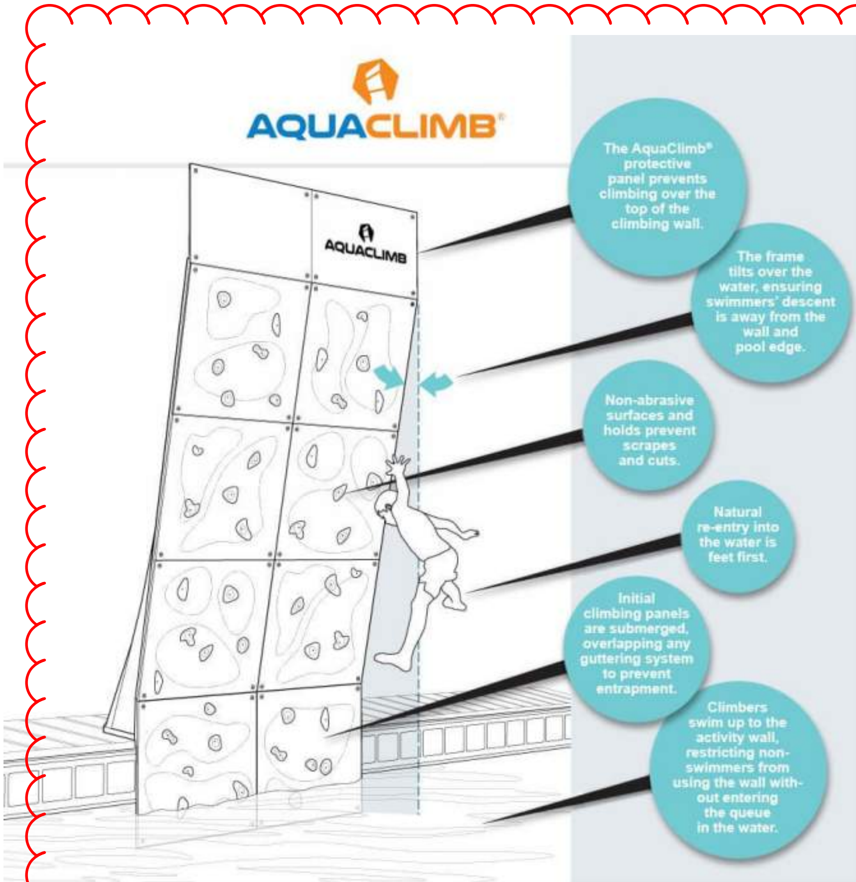


POOLSIDE ADVENTURES™

SAFETY

PROVIDE A SAFE WAY FOR POOL PLAY

AquaClimb® walls aren't just a fantastic poolside attraction. They're a safe way to play. They are specifically designed to eliminate the dangerous situations that can cause injury when sliding and diving. AquaClimb® is a safer alternative to diving boards and slides for both children and adults. Trust the brand that prioritizes you well being!



A SAFE WAY TO PLAY

- Each AquaClimb® comes complete with guidelines for safe use.
- AquaClimb® has clear protective panels to prevent climbers from climbing over the top of the wall.
- The AquaClimb® frame curves and hangs over the pool so that the natural re-entry into the water is feet first and the descent is away from the pool wall and edge.
- Non-abrasive surfaces and holds prevent scrapes and cuts.
- Natural re-entry into the water is feet first.
- Initial AquaClimb® climbing panels are submerged, overlapping any guttering system to prevent entrapment.
- Climbers swim up to the AquaClimb® activity wall, restricting non-swimmers from using the wall without entering the queue in the water.

Poolside Adventures products are recommended by the Aquatic Safety Research Group (ASRG) and are approved by state and

MEET OUR SAFETY TEAM

DR. TOM GRIFFITHS

Dr. Tom Griffiths is the President and Founder of Aquatic Safety Research Group, LLC. Recognized as an international leader in water safety, he has spent 38 years teaching, coaching and managing aquatics at three major universities. Griffiths has produced videos, textbooks, articles, and presentations in local health departments throughout the USA, in addition to major health and safety organizations like PlaySafe LLC, a member of the International Play Equipment Manufacturers Association.

AquaClimbs are designed and engineered to the following standards:

- AISC Manual of Steel Construction, 15 th Edition, ASD
- IBC 2018
- ASCE/SEI 7-16
- ASTM F24/F2291- 21- Standard Practice for Design of Amusement Rides and Devices
- ASTM F2461-20 Aquatic Play Equipment
- European Standards EN17164 – Climbing Walls for Use in the Water Area

AquaZip'Ns are designed and engineered to the following standards:

- ASTM F2291-18 Amusement Rides and Devices
- ASTM F2461-18 Aquatic Play Equipment

CHECK OUT THESE ARTICLES ON THE BENEFITS OF ROCK CLIMBING FOR KIDS!

various areas of aquatics focusing his efforts on safety. He has also conducted hundreds of aquatic facility and beach inspections across the nation and abroad and teaches full day Aquatic Risk Management seminars. Perhaps his most significant contributions are the Five Minute Scanning Strategy©, Griff's Guard Stations©, Disappearing Dummies, his research on Shallow Water Blackout, and the National Note & Float program. He has been an aquatic safety expert for more than 40 years and shares his knowledge, expertise, and experience worldwide. Griffiths just released the 3rd

Why Rock Climbing is Such an Awesome Activity For Kids

5 Mental Health Benefits of Rock Climbing

Poolside Adventures stands on a history of providing a safe climbing experience. The recommended rules provided on our signage and advised during the sales and acquisition process are extremely important to operating a safe and fun activity for all.

We have recently viewed four YouTube videos which show our walls not being properly supervised, having the safe operation signage being displayed at the wall and the wall itself being used in a potentially unsafe manner. Though no accidents have been reported we strongly ask that all facilities please review the safe operation signage with staff and follow our guidelines.

Thank you!

edition of the popular The Complete Swimming Pool Reference.

Read Dr. Tom Griffiths 10-Year Review of the AquaClimb (PDF)

RACHEL GRIFFITHS

Rachel Griffiths, M.A. is the Communication Director for Aquatic Safety Research Group. Rachel conducts water safety research to help prevent drowning and provides water safety education to the public. She is also the President of Note and Float Life Jacket Fund,

AQUATIC SAFETY
Research Group

We Take Water Safety Seriously

DATE: April 9, 2015
TO: Laura Grandner
FROM: Dr. Tom Griffiths
RE: AquaClimb

Ten Year Review

As you know, nearly ten years ago, we placed an AquaClimb climbing wall in the diving well on the Penn State University Campus to test and analyze your product. I was pleased to learn how attractive it was to our students, and how it promoted fun and fitness in the pool with a new and exciting activity that was safe.

Since that time, Rachel and I have inspected hundreds of aquatic facilities and discovered that AquaClimb Walls are a safer alternative to many other poolside recreational products, primarily because swimmers do not have to climb a ladder in a wet environment over a concrete swimming pool deck. Because AquaClimb is accessed from the water inside the swimming pool, rather the swimming pool deck, there is very little chance of a child falling and hitting the deck. Further, the AquaClimb is angled out over the water, and as a result it is very improbable, if not impossible, that a child can fall to the deck.

As an expert witness in courts of law, I see many horrific accidents involving diving boards and slides, but I have never heard of an accident of any kind, minor or major, involving an AquaClimb. As we travel around this country and abroad teaching our full day Aquatic Risk Management Seminars, promoting AquaClimb as a safe, fun, and fitness alternative to other pool products is an essential part of our program. As you recall, AquaClimb is particularly valuable as a replacement for diving boards which no longer meet the depth and distance requirement or because of inadequate protective railings. I might also add that I have never seen a pool product installed as quickly in a swimming pool as an AquaClimb. I truly believe in your product and remain available to answer any questions you and others may have concerning AquaClimb Climbing Walls.

1632 Glenwood Circle, State College, PA 16803 **T** 814.883.0058 **F** 814.234.0313 TomGriffiths@AquaticSafetyGroup.com
AquaticSafetyGroup.com

AQUATIC SAFETY
Research Group

We Take Water Safety Seriously

Regards,

T Griffiths

Tom Griffiths
President and Founder
Aquatic Safety Research Group, LLC

Rachel Griffiths

Rachel Griffiths
Communication Director
Aquatic Safety Research Group, LLC

1632 Glenwood Circle, State College, PA 16803 **T** 814.883.0058 **F** 814.234.0313 TomGriffiths@AquaticSafetyGroup.com
AquaticSafetyGroup.com

[redacted]

I. INTRODUCTION

The AquaClimb is an exciting new recreational and fitness component that offers new programming opportunities to aquatic facilities. Because the AquaClimb extends below the surface of the water, participants can easily swim up to the climbing wall and begin to traverse it without leaving the pool itself. Even those individuals without use of their legs can utilize the AquaClimb to exercise the upper body in a fun, challenging, and non-threatening way. Perhaps the most meritorious application of the AquaClimb is an alternative to a diving board in a swimming pool which no longer meets safe diving depth and distance requirements.

Climbers who fall from the AquaClimb will enter the water feet-first. To enter the water head-first from the climbing wall structure is almost a biomechanical impossibility. Prior to purchasing and installing an AquaClimb, aquatic facilities should contact their local regulatory agency (e.g. Health Department) to determine whether regulations, recommendations or suggestions regarding the safe installation and use of the AquaClimb exist. **AQUATIC SAFETY RESEARCH GROUP, LLC**, an independent and objective water safety consultant firm, remains available to assist facilities in answering questions concerning the safe use of the AquaClimb.

II. STANDARD OPERATING PROCEDURES

A. LIFEGUARDS

Whenever the AquaClimb is in use, it is recommended that a properly trained and certified lifeguard be assigned exclusively to the AquaClimb. The lifeguard should be strategically placed to supervise and control use of the structure and to minimize climber misbehavior. Because the apparatus will be positioned in deep water, a lifeguard with deep water skills and qualifications is needed. This lifeguard must also be trained for the proper use and monitoring of the in-water climbing structure. The lifeguard should be positioned close to the wall with a full and unobstructed view of the climbing wall and drop zone, with the ability to see underwater in the drop zone. The lifeguard must stay focused on the climbing wall whenever in use and attention should not be diverted to other areas of the pool. Lifeguard orientations, in-service trainings and emergency action plans should include the AquaClimb and should be reviewed and practiced regularly but at least monthly. In many pools, the best vantage point for proper surveillance may be directly across the pool facing the wall. However, each facility should determine where to best position supervisory staff to ensure a full and unobstructed view of the climbing wall and the drop zone.

The aquatic facility should also establish an entrance and exit pattern (left to right and right to left) to avoid congestion of swimmers waiting to swim into the drop zone to begin their ascent on the wall. This pattern can be changed daily or hourly. For larger installations allowing two or more climbers, additional safety precautions must be implemented to minimize the risk of a climber falling onto someone swimming into or out of the drop zone. One such approach is to direct climbers, once they have fallen from the wall, to swim to the closest edge of the drop zone so as to avoid swimming underneath a second climber.

B. DEPTH REQUIREMENTS

While most competitive swim agencies, including the National Collegiate Athletic Association (NCAA), require a minimum water depth of five (5) feet to dive headfirst from starting platforms, the AquaClimb, which promotes only feet-first entries, takes a more conservative approach, requiring a minimum water depth of five (5) feet for installation of its shortest three-panel wall. As panels are added vertically to the structure, minimum water depth requirements increase. To ensure safety of climbers, AquaClimb has applied commonly accepted safe head-first diving depths to feet-first entries from the structure.

We recognize that these depths are very conservative given that they are intended to minimize the risk of injury from head-first entries rather than from feet-first entries, but

[redacted]

absent additional research we cannot safely recommend alternative water depths which deviate from these nationally-accepted standards.

Minimum Depth Requirements for AquaClimb Installation			
Panel Height* - standard	3 panels (lowered)	4 panels (lowered)	5 panels (lowered)
Minimum Water Depth	5 feet	7 feet	8 feet

* Each panel measures approximately $3ft^2$ or $1m^2$

Minimum Depth Requirements for AquaClimb Installation			
Panel Height* - standard	3 panels	4 panels	5 panels
Minimum Water Depth	6 feet	8 feet	9 feet

C. Deck Clearances

Whenever possible, four feet of deck space should be maintained between the end of the support structure and the perimeter pool wall or fence. If less than four feet is available, a combination of pedestrian control stanchions and traffic cones should be used to direct patrons around the support system. To best accommodate persons with disabilities, a minimum of three feet (36”) clearance around the support structures should be maintained. Even with spacious decks, stanchions and cones always come highly recommended, as they minimize the risk of someone coming into contact with the structure. Customers are advised to check building and fire codes to determine whether support structures can permissibly block access to the pool deck, particularly in cases where the support structure would come within three feet of a wall.

D. NUMBER OF CLIMBERS

With a one panel or two panel wide AquaClimb, it is ***highly recommended*** that only one climber use the AquaClimb at a time. With a three panel or wider AquaClimb, however, there is an opportunity to allow more than one climber on the wall at the same time. Multiple climbers should only be allowed when there is no possibility of one climber either interfering with or falling on top of another climber. Multiple climbers should be instructed to climb the wall vertically rather than to traverse the wall horizontally. Climbers should also maintain a distance of at least one panel from other climbers to minimize the risk of climber interference, horseplay and accidental concurrent falls.

E. VERIFIED SWIMMERS ONLY

Because the AquaClimb is installed in deep water (see minimum depth requirements above), this climbing attraction is to be used only by "swimmers" – persons with verified swimming ability. The attractive colors and the fun activity that the structure provides, are likely to draw younger, weaker swimmers to the climbing wall. These persons should be properly screened to ensure they possess the requisite deep-water skills necessary for using the structure. Following standard aquatic safety practices, anyone wishing to enter deep water to use the AquaClimb should be given a swim test. A recommended swim test would be to have the swimmer/climber jump into ***chest-deep*** water, surface, swim the equivalent length of the buffer zone and return to the starting point. Requiring climbers to tread water for 30 – 60 seconds comes highly recommended. Swim tests should be conducted in chest-deep water to maximize swimmer safety.

[redacted]

F. DROP ZONE

Climbers will fall from the wall into the water. It is therefore imperative to keep people from entering the “drop zone” where they would risk being struck by a falling climber. No other swimmers should be allowed into the drop zone when a climber is on the wall.

3 panel high:

4 panel high:

5 panel high:

G. FEET-FIRST ENTRIES ONLY

While head-first entries, including dives, are improbable to perform from the face of the climbing wall, and although the depth requirements for the various climbing wall configurations are extremely safe and tend to be conservative, climbers must be warned that all entries into the water from the AquaClimb should be feet-first. Climbers who intentionally violate this safety rule should be prohibited from using the AquaClimb.

[redacted]

H. UNDERWATER ACTIVITIES

Participants should not be allowed to play with the structure itself, particularly while submerged. While there are no hidden hazards or entrapment potentials inherent in the AquaClimb, it is intended for above-water use. It is not intended or designed for underwater use by climbers. Playing underwater around the structure makes it more difficult for the lifeguard to properly supervise the activity. This could lead to injury should a climber fall onto someone who was playing underwater in the drop zone.

[redacted]

III. Suggestions for Safety Signage

Perhaps the most appropriate place to place caution/warning signs would be on the side. The three most important warnings should include:

- “Swimmers Only”
- “No Head First Entries”
- “Only One Climber at a Time unless there are 1-2 clear panel between climbers”

These three warnings can be placed together on the same sign in the appropriate colors (red/white, black/yellow, orange/black). Additional signs/warnings may be mounted on the rear of the support structure.

NAC
ARCHITECTURE

Patty Hayes, Board Chair
Washington State Board of Health
PO Box 47990
Olympia, WA 98504-7990

AQUATIC CENTER at MLK JR. PARK, Yakima

Variance Letter Date: 2024.06.20

STATE IDENTIFICATION: State ID Facility #: F0476 Project #:2024003

Facility Information:
Aquatic Center at MLK Jr. Park (New outdoor pool facility with 5,300sf pool building and two leisure pools)
Plan Submittal: Drawing Plans have been submitted for review.

Aquatic Center at MLK Jr. Park, City of Yakima

Owner Contact:	Ken Wilkinson	Phone: 509-576-6416
Owner Address:	129 N 2nd street	Yakima, WA 98901
Facility Address:	610 S 9th Street	Yakima, WA 98901
Owner Representative:	Brooke Hanley (NAC Architecture) 509-838-8240	

Variance Request Contact:
NAC Architecture: Brooke Hanley Phone: 509-838-8240 Email: bhanley@nacarchitecture.com

Variance Request Citation:
WAC 246-262-160 states *the board may grant a variance from requirements of chapter* ***246-262*** *WAC if, in the sole discretion of the board, data and/or research provides sufficient evidence that the RWCF (attraction, device, equipment, procedure, etc.), will adequately protect public health and safety, as well as water quality.*

Variance Request: Code language related to Diving Envelope (WAC 246-262-010(21) & WAC 246-262-060(5)(vi)) for the **AquaZip'N Rope Swing** attraction.

Items noted in review letter include:

- **Aqua Zip'N Rope swing** attraction receiving pool shall conform to the CNCA or FINA standards (depth application and setbacks)

In the Department of Health review response letter issued by Justin Law dated May 22, 2024, Justin requests NAC Architecture (NAC) and WaterTechnology, Inc. (WTI) to address important concerns regarding public safety related to the receiving pool for the proposed **AquaZip'N Rope Swing** attraction in Pool B. The concern is to address the minimum depth of the pool to be compliant with the WAC 246-262-010(21) & WAC 246-262-060(5)(c)(vi) regarding diving envelopes for features where users enter the water from above the water surface.

On behalf of the City of Yakima; NAC & WTI respectfully requests your consideration of the current pool depth design at the rope swing for the future Aquatic Center at MLK Jr. Park. To support this request we provide the attached information, engineering exhibits, and following commentary:

- The review letter states that the "diving envelope" from WAC 246-262-010(21) applies to **all attractions** where users enter above pool water level and therefore requires the CNCA (enter less than 20" above the water surface) or FINA (enter 20" or greater above the water surface) water depths. We submit that the attached engineering calculations for the **AquaZip'N Rope Swing** product will demonstrate that the manufacturer's required water depths and the designed water depths provided at the Yakima Aquatic Center are more than sufficient to protect the safety of the users allowed to participate in this attraction. Calculations were completed for a 72" tall, 250lbs person, any body size smaller than the max would perform better, not worse. The manufacturer's minimum depth requirement is 4 feet. Although the current Yakima receiving pool water depth exceeds the manufacturer's recommendations, the applicant proposes to move the rope swing to the deeper water directly west to provide a consistent 6-foot deep zone for this attraction, in an effort to alleviate DOH concerns. The applicant proposes to remove the drop slide from the project and in its place locate the rope swing instead. Please review the attached data in support of using the manufacturer's depth requirements in lieu of the CNCA diving envelope dimensions.

- WAC 246-262-060(5)(c)(vi) appears to apply specifically to "diving envelopes in pools or areas of pools designated for diving activities". The applicant submits that diving activities are generally defined as plunging into the water headfirst. Diving headfirst into water results in the need for deeper water to avoid a head & neck collision with the pool floor which is different than a feet-first or tucked entry plunge where the body is significantly slowed in the first two feet of water. The **rope swing** safety guidelines (provided in the exhibits) will note that users are required to enter the water in a feet-first manner. Diving from the unit is prohibited. The engineering calculations completed also assumes a feet-first plummet into the water.

- The Model Aquatic Health Code also addresses the complexity of "other aquatic features" like this and would suggest that the manufacturer recommendations for design and operation would be adequate to install the feature.

  4.12.10[A] Other Aquatic Features Other AQUATIC FEATURES not otherwise addressed in the CODE, including but not limited to climbing walls, inflatables, and play structures, shall not be installed unless designed and operated in accordance with all manufacturer's installation and operations recommendations.

- 'A-frame' signs with all written safety guidelines will be publicly displayed near the rope swing (see page 8 for example) to meet the criteria of WAC 246-262-070(10). Participants will be screened by lifeguards to ensure they are within the minimum and maximum size requirements.

- See attached rope swing diagrams to understand how the hand holds are provided on the rope at even intervals between 57” and 87” above the deck. The relatively low height of the hand holds does not allow the users to gain much elevation above the water as they slide out over the surface.

- Safety padding rated for falls from 6ft or less are provided around the base of the rope swing structure and down the face of the pool wall to prevent injuries at the corner of the gutter. The rope swing itself has a safety catch, so when the user swings out over the water, they are prevented from sliding back toward the wall. Once the user drops into the pool, the rope self-retracts so the next user does not need to reach out over the water to grab the rope.

- This pool will be lifeguarded at all times while in operation and the lifeguard staff will be the first line of defense to screen bathers to make sure they are experienced swimmers, instruct swimmers on proper use of the attraction, and direct proper swimmer circulation to and from the activity within the pool to avoid congestion or collisions. The **rope swing** will have a dedicated lifeguard to closely supervise the safety of swimmers when the attraction is open for use.

- Injury statistics requested by the review letter are not available from the manufacturer or another source at this time.

- The **AquaZip’n** has also been designed and engineered to meet the following standards:
  - ASTM F2291-18 Amusement Rides and Devices
  - ASTM F2461-18 Aquatic Play Equipment
  - AISC Manual of Steel Construction
  - Other industry standards listed in the product data attached

- The City of Yakima specifically requested a pool design that would have a variety of intriguing activities for their patrons but would not need water deeper than 6-7ft. Pools deeper than 6-7ft come with their own safety risks and lifeguarding challenges. Shallow water is easier to supervise and guard. Rescues are much more likely to be needed in deep water where a bather in trouble cannot push off the bottom of the pool to bob back above the surface quickly until the lifeguard can assist them. Yakima is dedicated to making this facility fun while also as safe as possible for their community members and patrons.
-
- NAC submits that the design as described above and substantiated in the attached documentation meets the intent of providing a safe receiving pool for the **AquaZip’N Rope Swing** feature. NAC, WTI, and the City of Yakima respectfully requests a variance accordingly. If the State Board of Health has any follow-up conditions or actions required of the owner/operator, we are committed to implementing them.

NAC Architecture (NAC) has teamed with Water Technology (WTI) on numerous aquatic projects and so we have a history of producing these projects successfully. WTI has been designing Aquatic venues for over 40 years. WTI is widely known in the industry as one of the leading aquatic design firms in North America. As one of the industry's leaders, WTI has represented the waterpark industry during CPSC meetings on review of VGB rules and has also been involved in reviewing/editing sections of the MAHC. They are also represented in the Washington DOH committee to update the existing administrative code to adopt a more comprehensive aquatic code like the MAHC. The NAC and WTI commitment to safe aquatic facilities is proven. The design of the receiving pool at the **AquaZip'n Rope Swing** for the Yakima Aquatic Center will not put the health and safety of the public at risk. The City of Yakima, having operated a public pool for many years is experienced and committed to the safety and the welfare of their patrons. On behalf of the City of Yakima, NAC Architecture would like to thank you for your consideration of this Variance Request. Please feel free to contact me with any questions you may have regarding this request.

Thank you,

Brooke Hanley

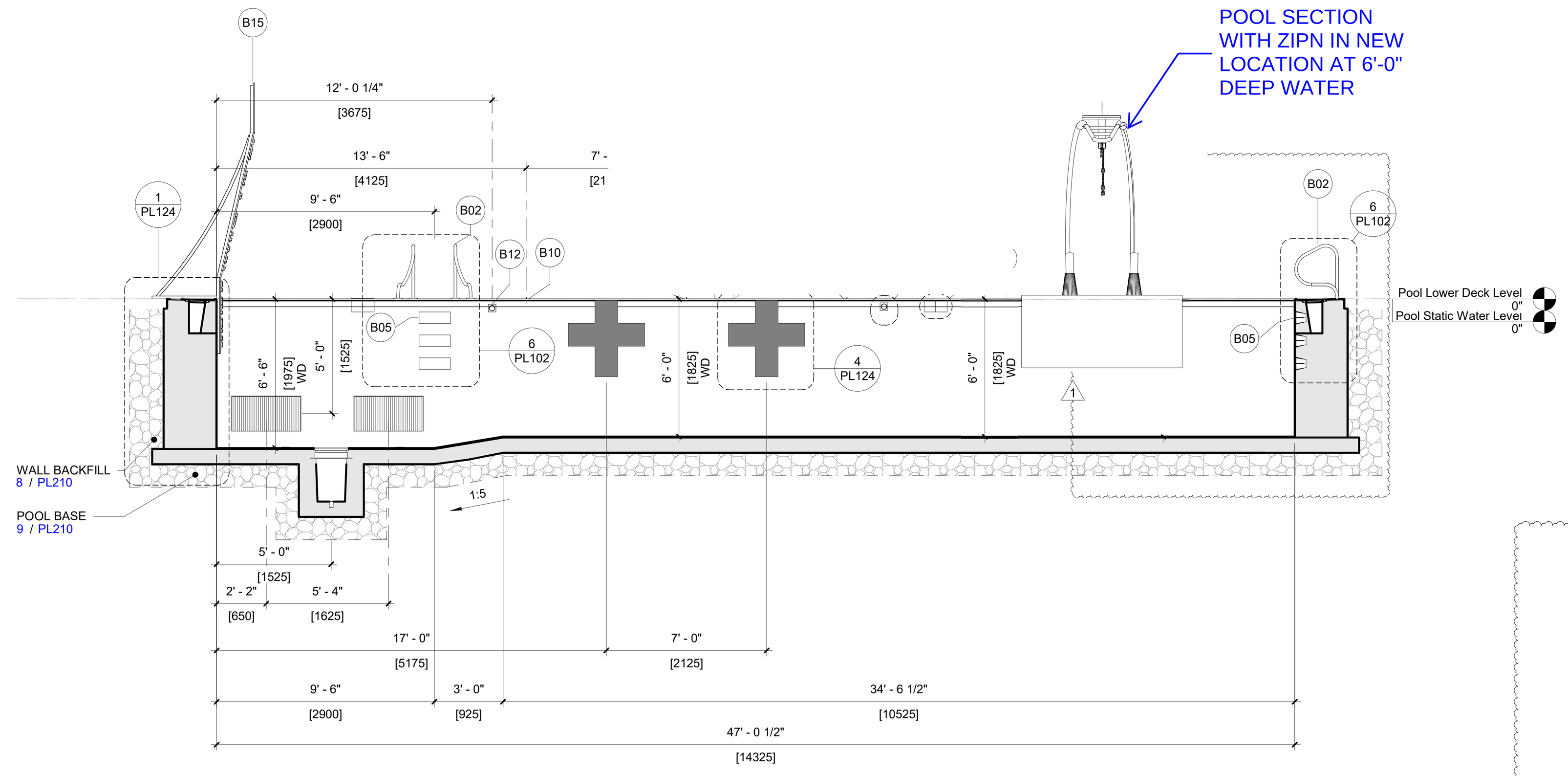
Brooke Hanley, AIA, Principal Architect, NAC Architecture

Attachments:

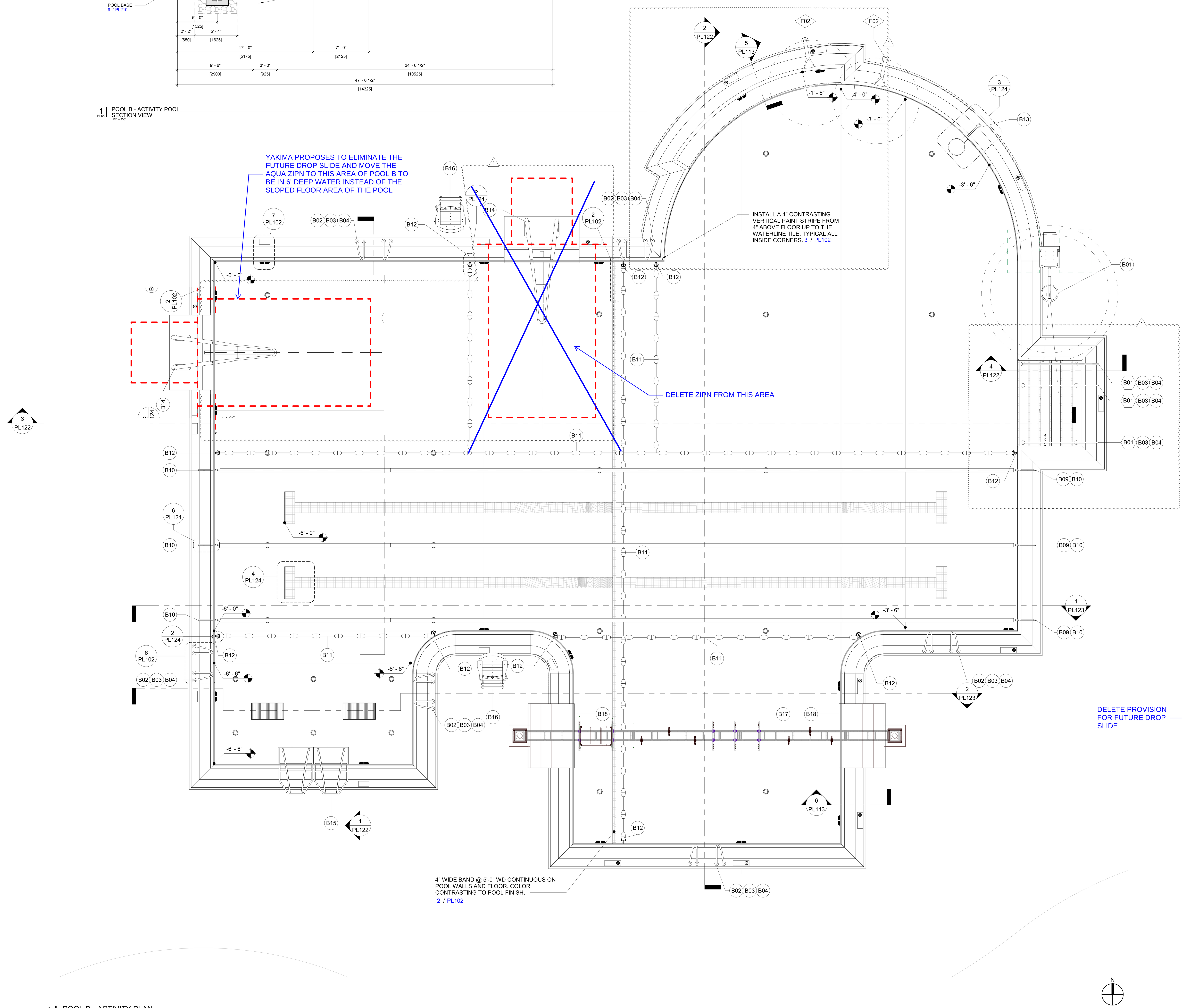
- AquaZip'n Safety Information and Fall Zone Engineering, including a floor plan and section of the receiving pool with proposed changes for the Yakima Aquatic Center.

REVISIONS

REV NO.	DESCRIPTION	DATE
1	CHANGE PROPOSAL	04/16/2024



1 POOL B - ACTIVITY POOL SECTION VIEW



1 POOL B - ACTIVITY PLAN PLAN VIEW

POOL B-ACTIVITY DATA			
DESCRIPTION	QTY	UNITS	
POOL PERIMETER	314'-0"	FEET	
WATER SURFACE AREA	3,832	SQUARE FEET	
POOL WATER TEMPERATURE	84	°F	
POOL VOLUME	136,514	GALLONS	
SURGE TANK OPERATING VOLUME	7,415	GALLONS	
TOTAL VOLUME OF WATER	147,268	GALLONS	
CIRCULATION RATE	1,033	GPM	
TURNOVER/VOLUME/FLOW	60 MIN.	19,330 GAL.	322 GPM
TURNOVER/VOLUME/FLOW	180 MIN.	127,938 GAL.	711 GPM
FILTRATION RATE	12.66	GPM/FT²	
BACKWASH FLOW	306	GPM	
SURGE FACTOR	1.06	GAL/SQFT	
AVAILABLE SURGE CAPACITY IN SURGE TANK	4075	GALLONS	

SCHEDULE - BASIS OF DESIGN - POOL B

POOL ID	EQUIPMENT ID	EQUIPMENT	QTY	MANUFACTURER	DESCRIPTION
B	01	POOL LIFT	1	SR SMITH, AQUA CREEK, OR EQUAL	STANDARD ANCHORED, ROTATIONAL POOL LIFT, WITH 400 LB MINIMUM LIFTING CAPACITY. MUST MEET ALL APPLICABLE ADA REQUIREMENTS, WHILE MAINTAINING REQUIRED DECK CLEARANCE. PACKAGE TO INCLUDE ARMRESTS, ANCHOR, LIFT COVER, BATTERY CHARGER, AND CADDY
B	02	GRAB RAILS (PAIRS)	6	PARAGON AQUATICS, SPECTRUM AQUATICS, SR SMITH OR EQUAL	PRETZEL BEND STYLE, 1.50" OD x .120 WALL THICKNESS, 500 GRIT FINISH MIN.
B	03	ESCUTCHEON PLATE	34	PARAGON AQUATICS, SPECTRUM AQUATICS, SR SMITH OR EQUAL	STAINLESS STEEL ROUND ESCUTCHEON FOR 1.50" O.D. RAILS
B	04	WEDGE ANCHOR	34	PARAGON AQUATICS, SPECTRUM AQUATICS, SR SMITH OR EQUAL	CAST BRONZE, 4-1/4" LONG, ACCEPTS 1.500" OD TUBING
B	05	IN-WALL STEPS	18	PARAGON AQUATICS, SPECTRUM AQUATICS, SR SMITH OR EQUAL	17-1/2" x 6", INJECTION MOLDED PLASTIC, PEBBLE TEXTURE, 1/4" WALL THICKNESS
B	09	LANE DIVIDERS	3	COMPETITOR SWIM PRODUCTS	4" WAVE QUELLING RACING LANE LINE, COLORS BY OWNER / ARCHITECT
B	10	DalFLEX LANE LINE ANCHOR	6	DALDORADO	12" – NON-CORROSIVE PVC FLIP UP LANE LINE ANCHOR TO BE USED WITH DALDORADO PARALLEL GRATING. INCLUDES FLIP-UP HATCH, BASE UNIT, & SILICON COVERED SS BRAIDED STRAP EXTENSION WITH HOOK. CAN BE USED WITH THE DalFLEX 8" OR 14" LANE LINE EXTENSION.
B	11	SAFETY ROPE	6	PARAGON AQUATICS	3/4" POLYETHYLENE ROPE WITH 5"x9" HANDI-LOCK FLOAT, VERIFY LENGTH WITH PLANS
B	12	CUP ANCHOR	10	PARAGON AQUATICS, SPECTRUM AQUATICS, SR SMITH OR EQUAL	4" SQUARE 304L SS ANCHOR AND 304L SS EYE BOLT
B	13	BASKETBALL HOOP	1	SR SMITH	STAINLESS STEEL BASKETBALL HOOP WITH ROCKSOLID ANCHOR
B	14	AQUA ZIPN	1	AQUACLIMB	DECK-MOUNTED OVERHEAD ROPE SWING, WITH SELF-RETRACTING TROLLEY, POWDER-COATED STAINLESS STEEL WITH HIGH TENACITY POLYESTER ROPE. INCLUDES SAFETY PAD-UNIVERSAL, WITH 316 SS HILTI FLUSH MOUNT CONCRETE ANCHORS.
B	15	AQUACLIMB	1	AQUACLIMB	2 WIDE X 3 HIGH AQUATIC CLIMBING WALL
B	16	LIFEGUARD CHAIR	2	TAILWIND, KEIFER, SPECTRUM AQUATICS, SR SMITH OR APPROVED EQUAL	RECYCLED PLASTIC WITH 304 SS HARDWARE, COLOR BY OWNER/ARCHITECT 40" SEAT HEIGHT (OWNER'S SAFETY CONSULTANT TO SPECIFY LOCATION.)
B	17	NINJACROSS	1	NINJACROSS	AQUATIC OBSTACLE COURSE
B	18	SAFETY PAD	3	PLAYTIME	WALL AND DECK SAFETY PAD AT NINJACROSS SYSTEM

SCHEDULE - CUSTOM RAILGOODS - POOL B

POOL ID	EQUIPMENT ID	EQUIPMENT	QTY	MANUFACTURER	DESCRIPTION
B	01	HAND RAIL	3	PARAGON AQUATICS, SPECTRUM AQUATICS, SR SMITH OR EQUAL	CUSTOM FABRICATED, 316L SS, 1.50" OD x .120 WALL THICKNESS, 500 GRIT FINISH MIN.
B	02	HAND RAIL	2	PARAGON AQUATICS, SPECTRUM AQUATICS, SR SMITH OR EQUAL	CUSTOM FABRICATED, 316L SS, 1.50" OD x .120 WALL THICKNESS, 500 GRIT FINISH MIN.

SCHEDULE - WATER FEATURE - POOL B

DELETE PROVISION FOR FUTURE DROP SLIDE

POOL ID	FEATURE ID	FEATURE	QTY	MANUFACTURER	DESCRIPTION	GPM (ea)	GPM (Total)
~~B~~	~~F01~~	~~DROP SLIDE~~	~~1~~	~~SPLASHTACULAR~~	~~FUTURE SLIDE~~ PROVIDE PIPING CAPPED ONLY	~~500~~	~~500~~
B	F02	WATER SPRAY	2	WATERPLAY	PIPE DELUGE-FAN SPRAY FEATURE	60	120

CONFORMED SET

CITY OF YAKIMA
YAKIMA POOL
YAKIMA WA

WTI WATER TECHNOLOGY INC.
World Leaders in Aquatic Planning, Design and Engineering
100 Park Avenue | Beaver Dam, WI 53916
t 920.887.7375

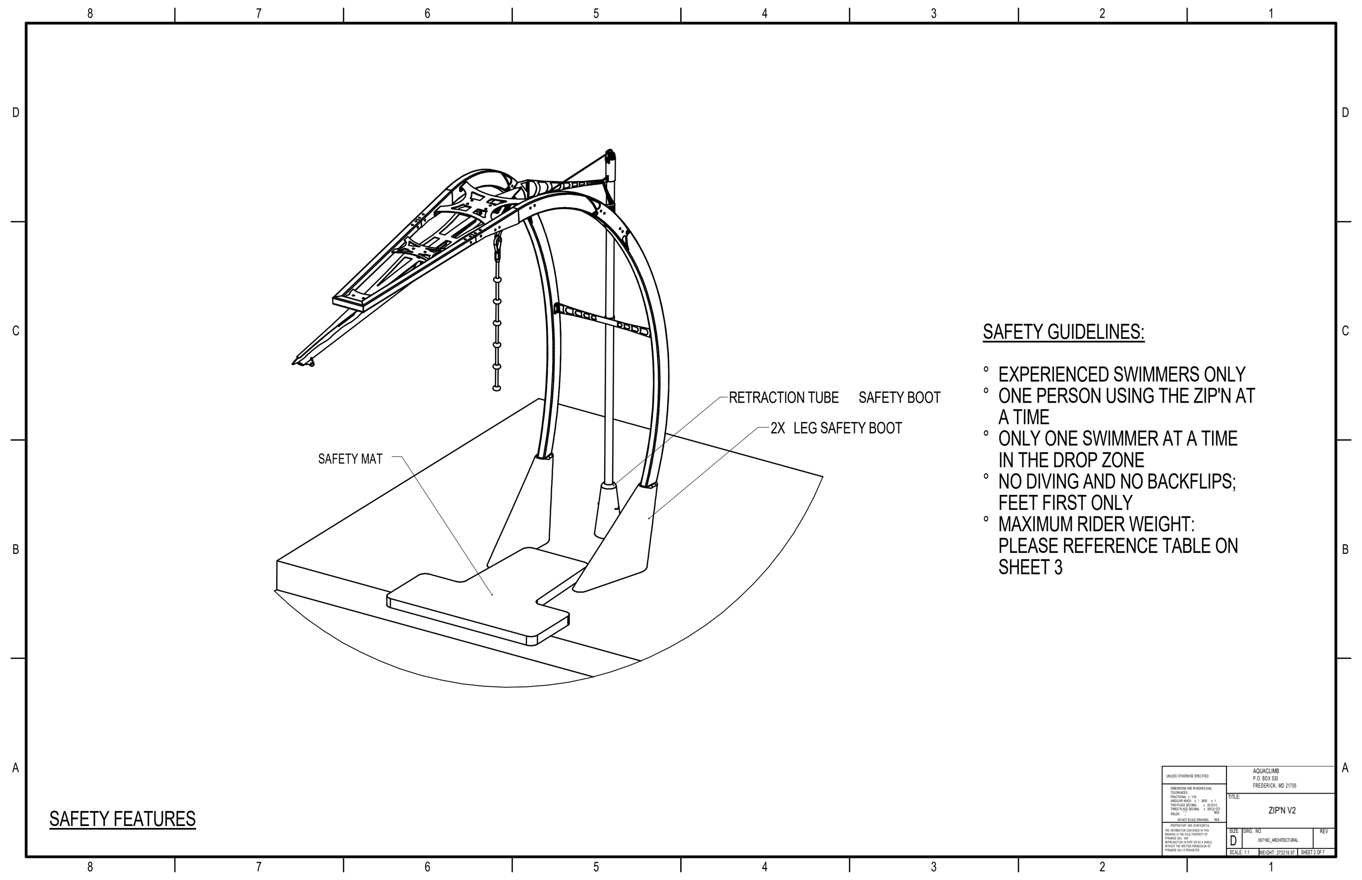
NAC ARCHITECTURE
nacarchitecture.com
1203 WEST RIVERSIDE AVENUE
SPOKANE WA 99201
P:509.838.8240

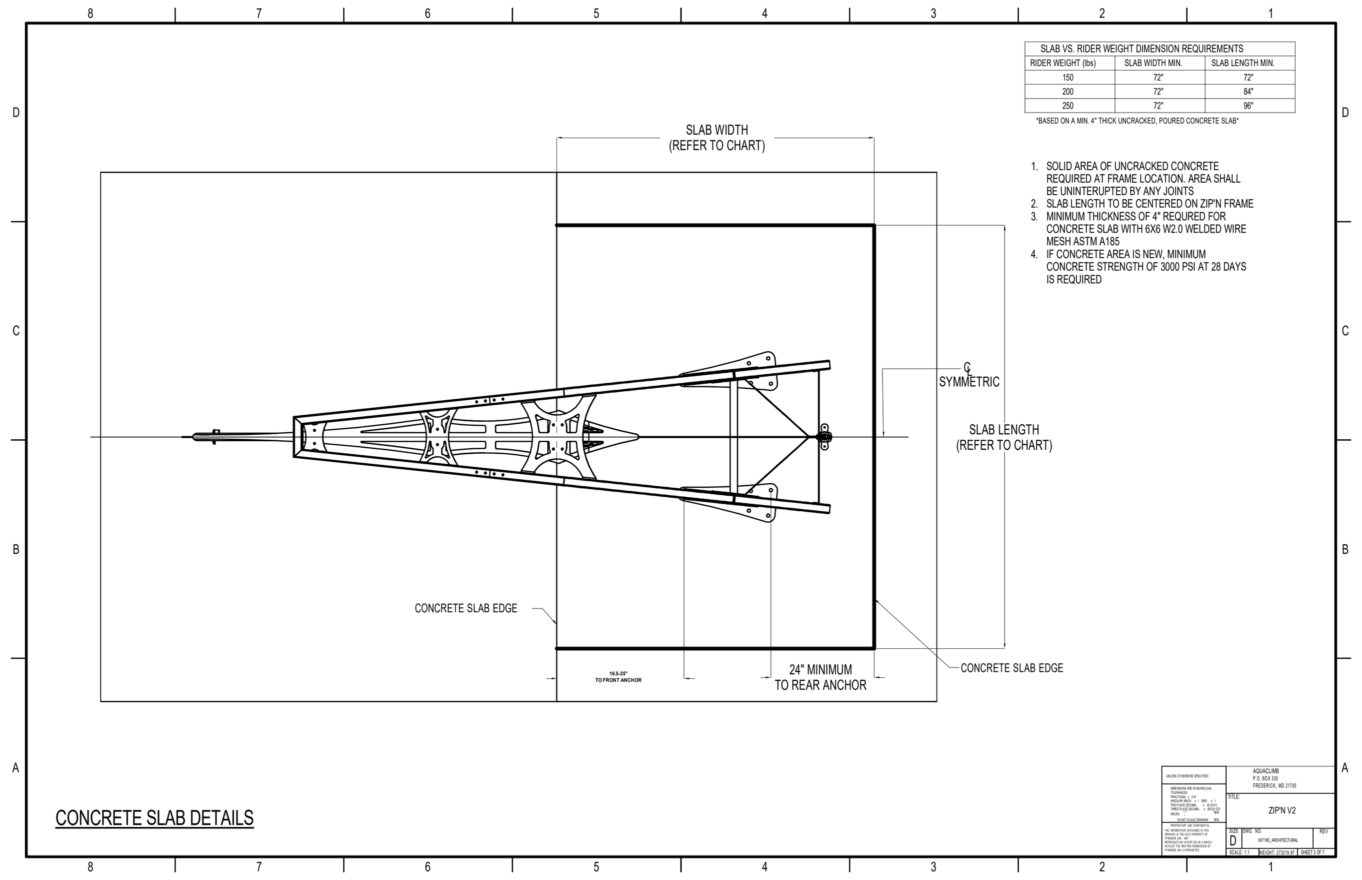
NAC NO 111-22082
ISSUE DATE: 4/16/24
PROJECT NUMBER: 22314
DRAWN BY: T.ED
CHECKED BY: ACC

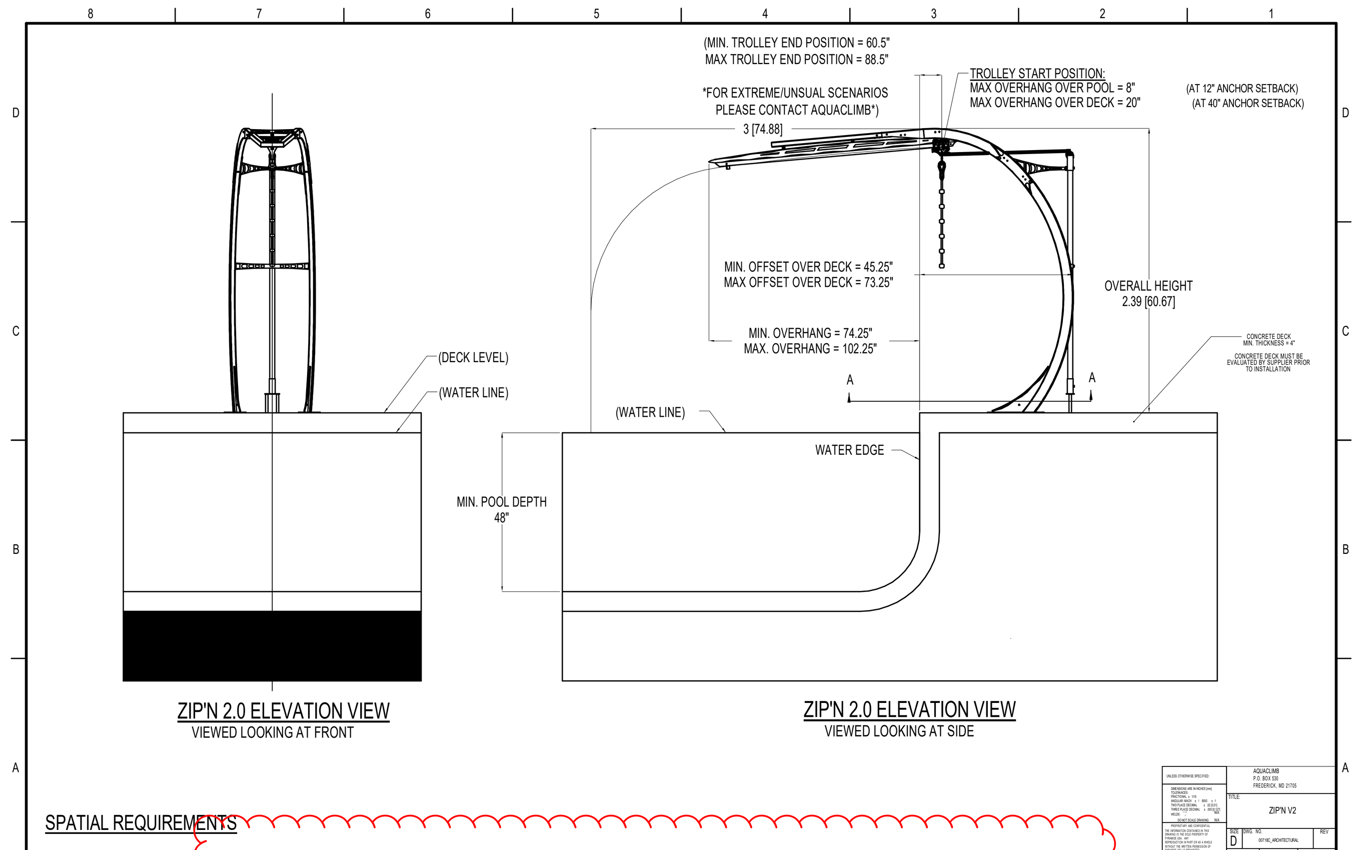
7893 REGISTERED ARCHITECT
MATTHEW W. FREEBY
STATE OF WASHINGTON
4/16/2024

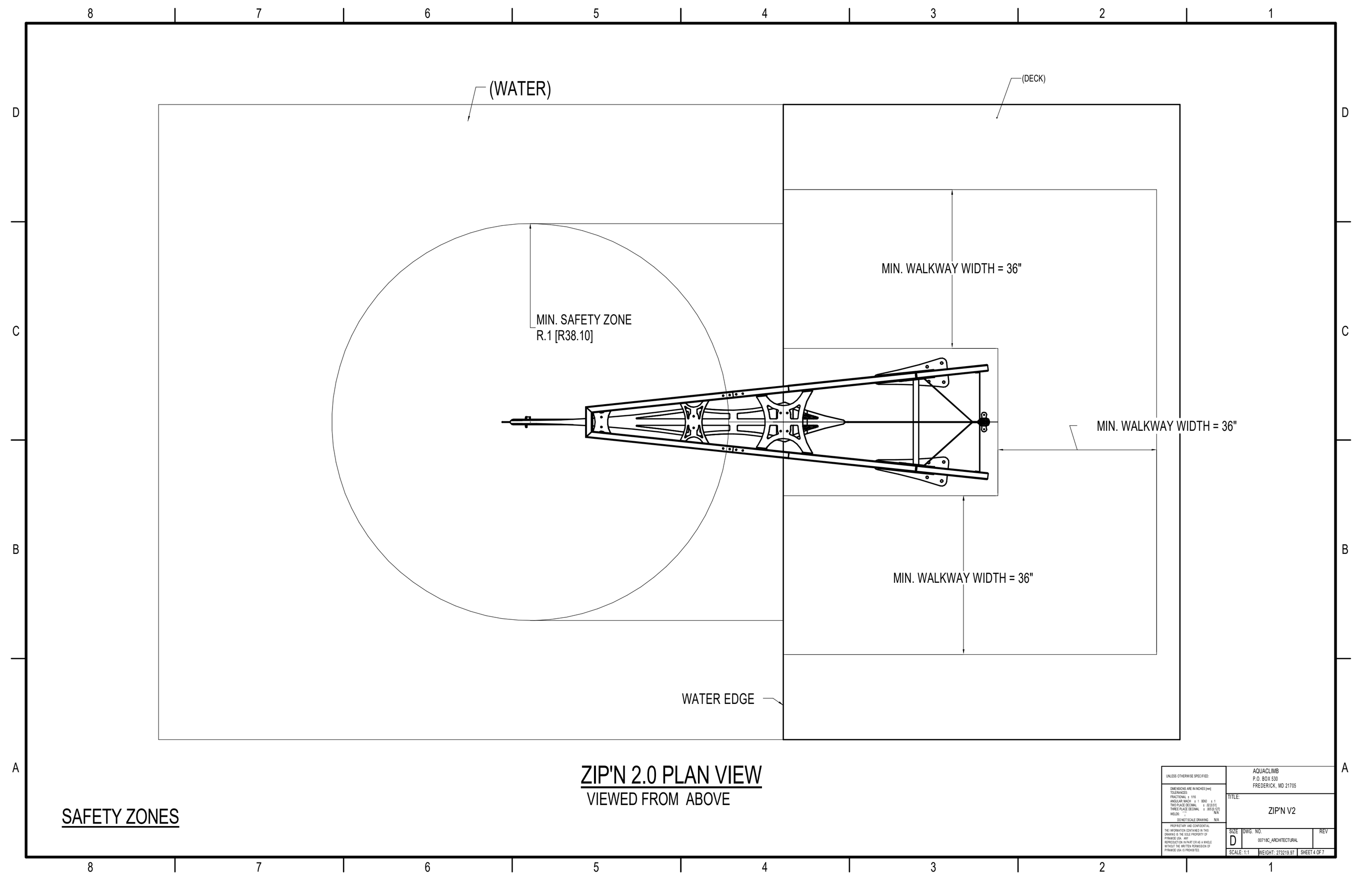
POOL B - ACTIVITY POOL PLAN

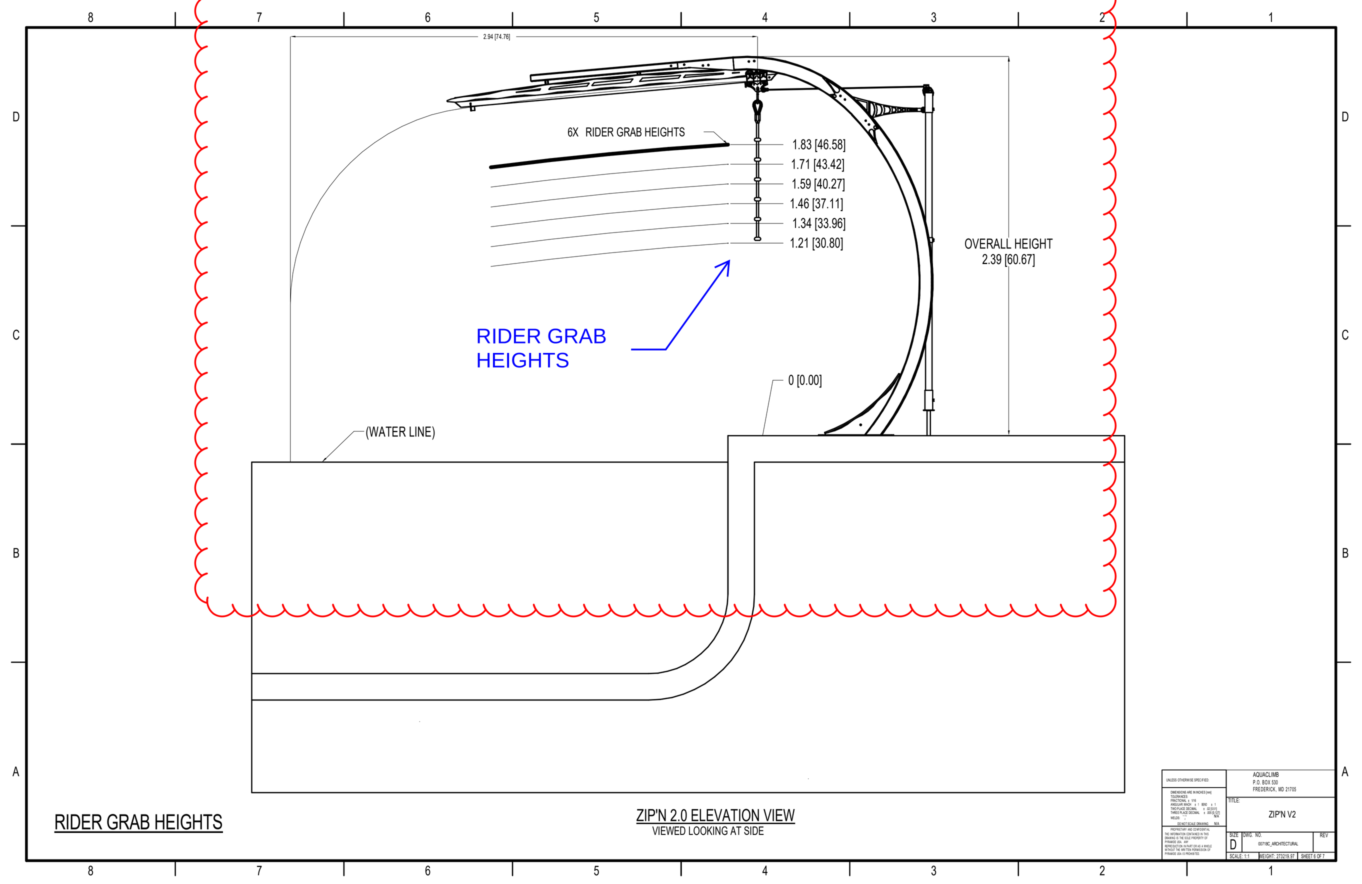
PL120

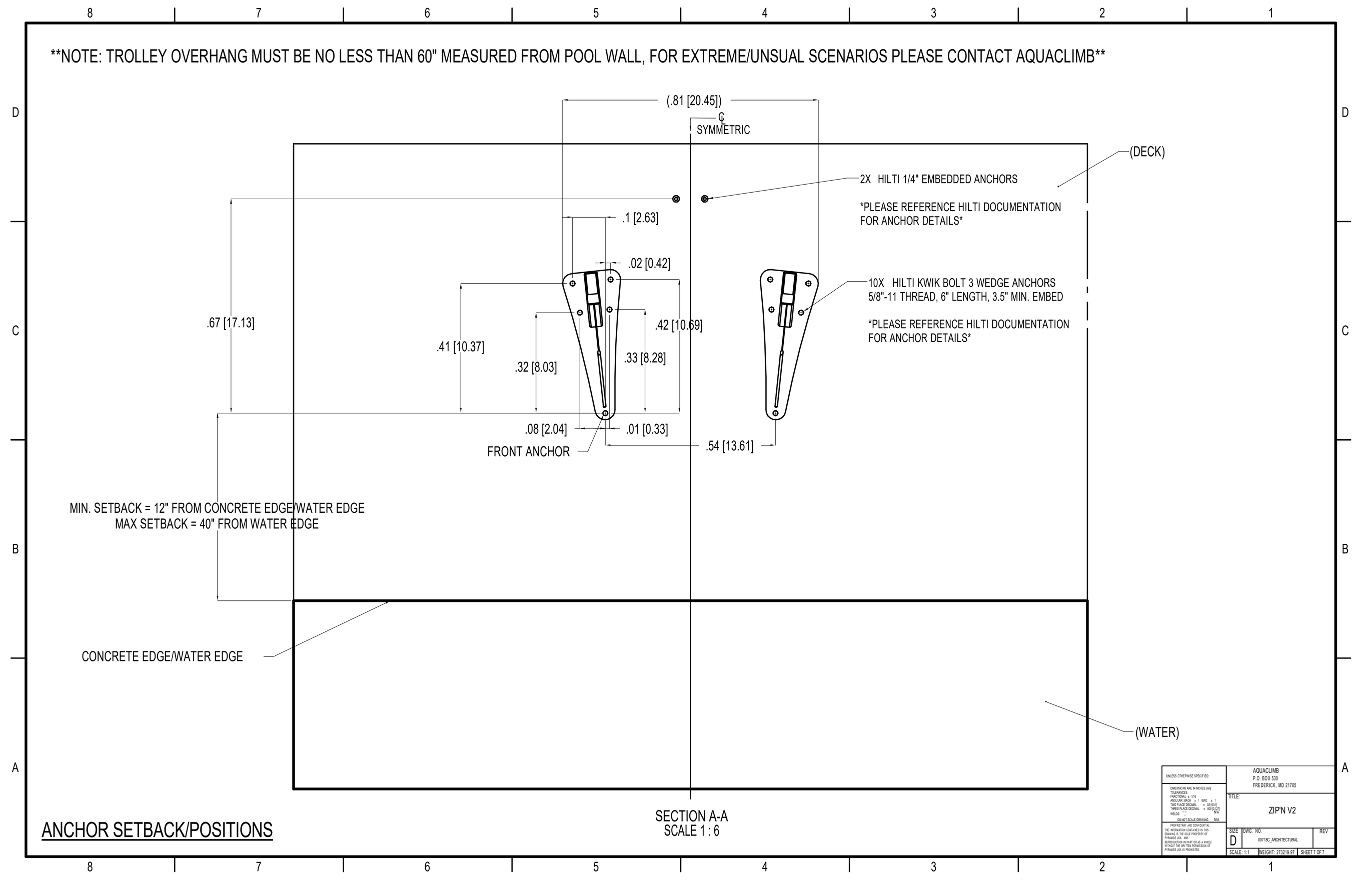


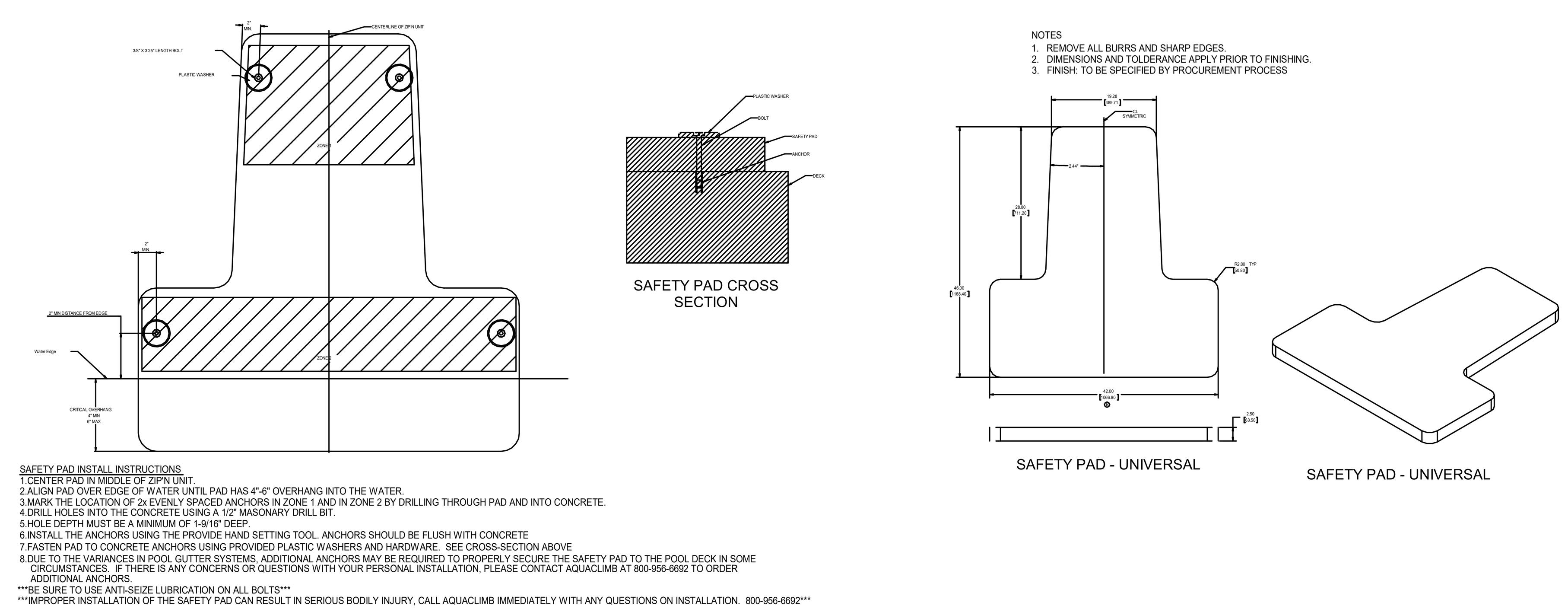




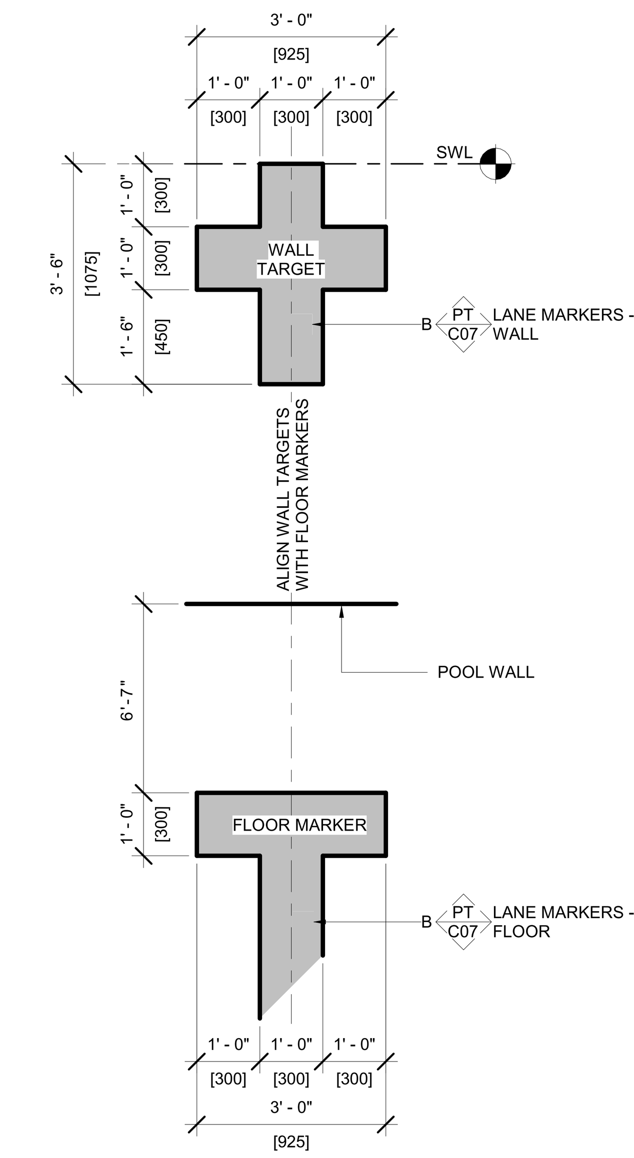






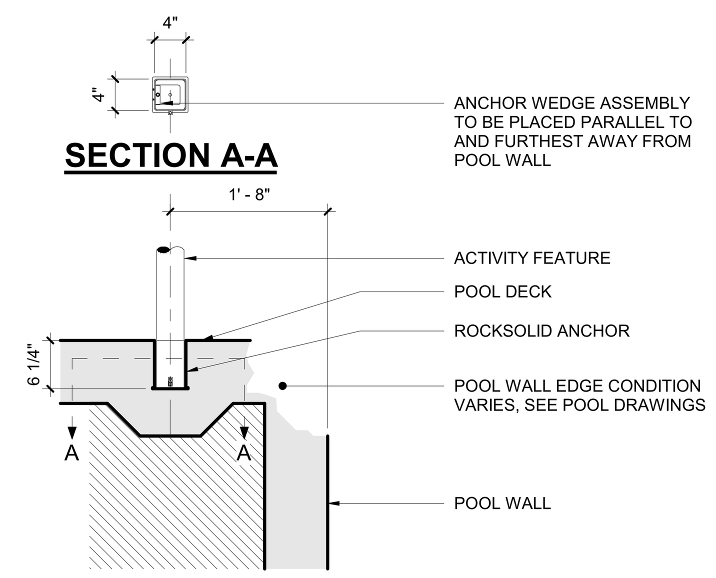


7 | AQUA ZIPN
DETAIL VIEW
NOT TO SCALE



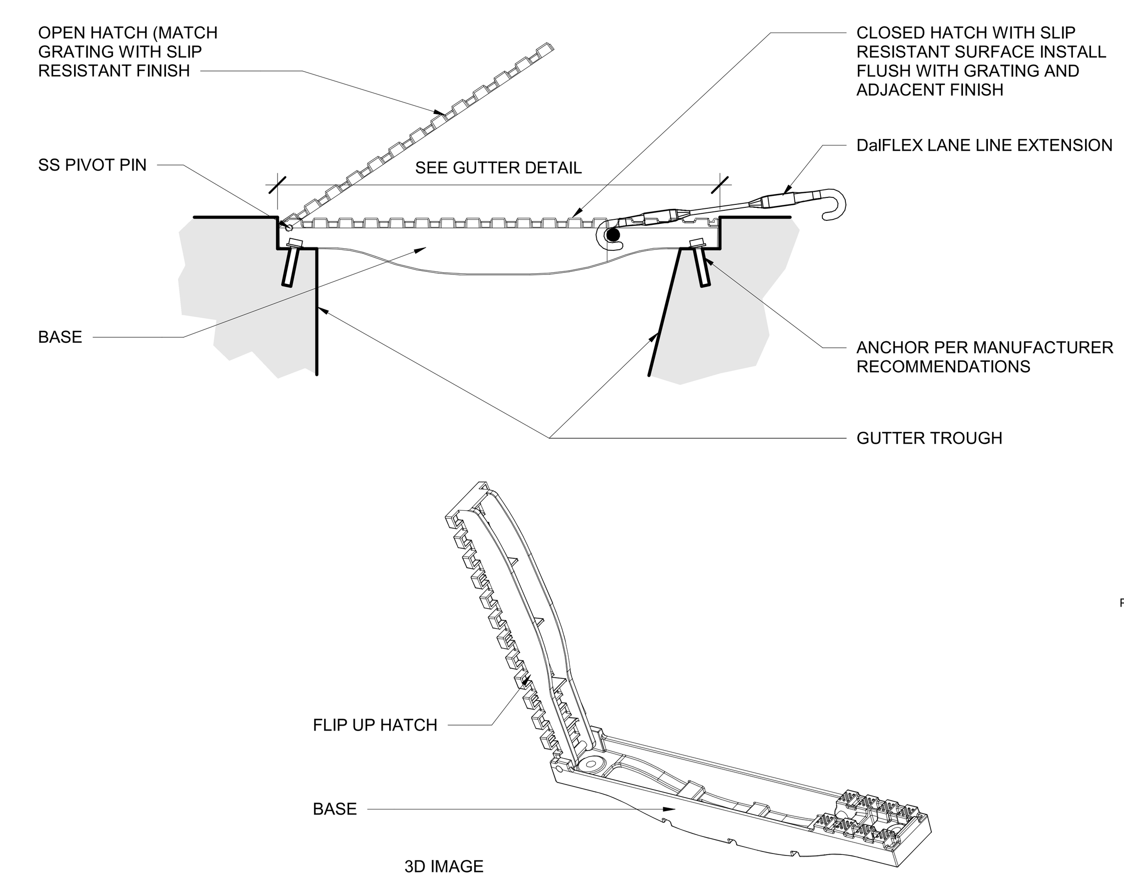
NOTES:
1. ALL PAINT SHALL BE IN A CONTRASTING COLOR TO POOL FINISH, BOTH FLOOR AND WALL. CONFIRM PAINT COLOR WITH OWNER/ARCHITECT

4 | FINISH - FLOOR MARKER AND WALL TARGET
DETAIL VIEW
1/2" = 1'-0"

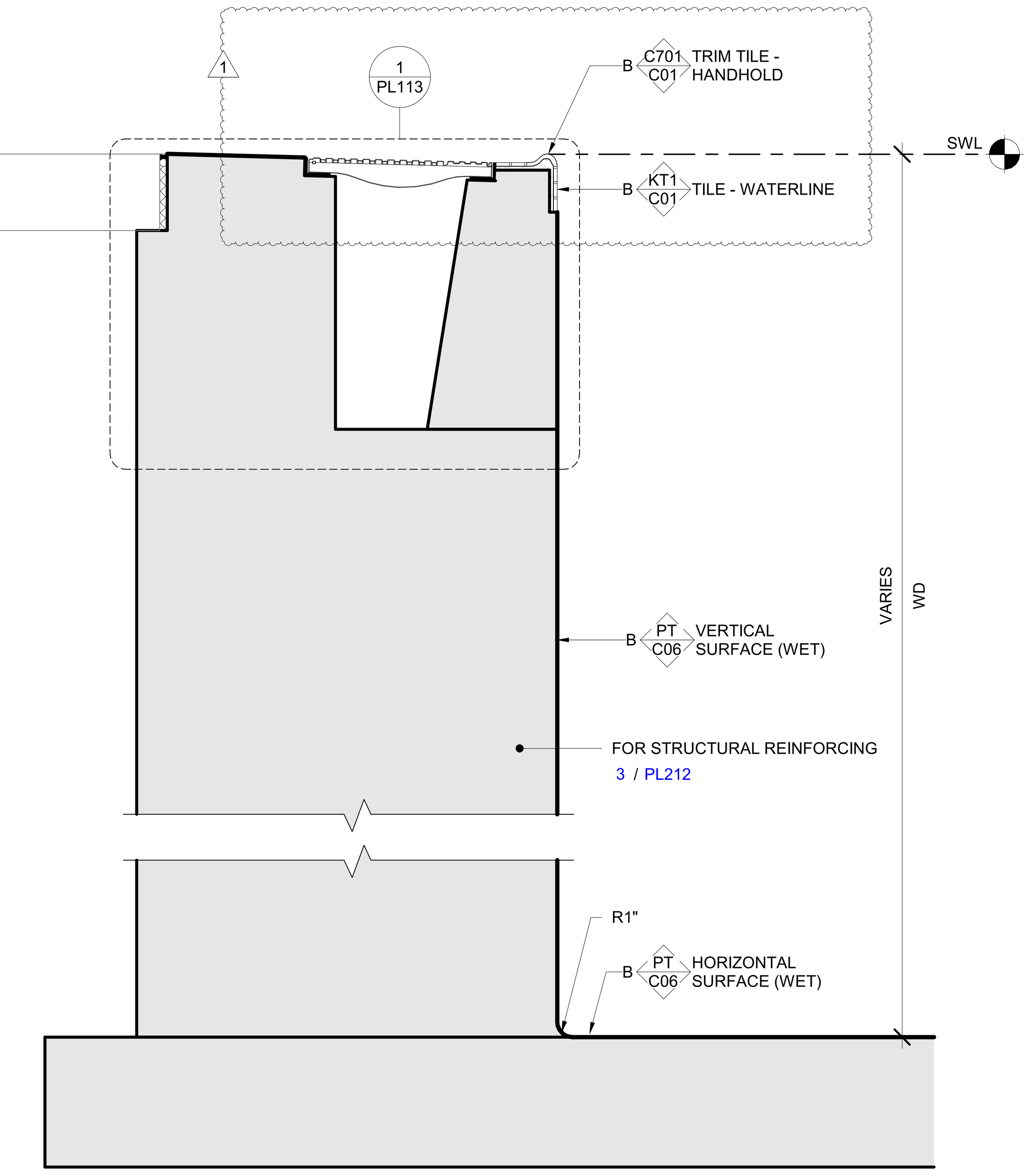


NOTES:
1. CONCRETE CLEAR COVER AT ALL ANCHOR EMBEDMENTS SHALL BE 6" MINIMUM. THICKEN SLAB IF NECESSARY TO ACHIEVE MINIMUM COVER.

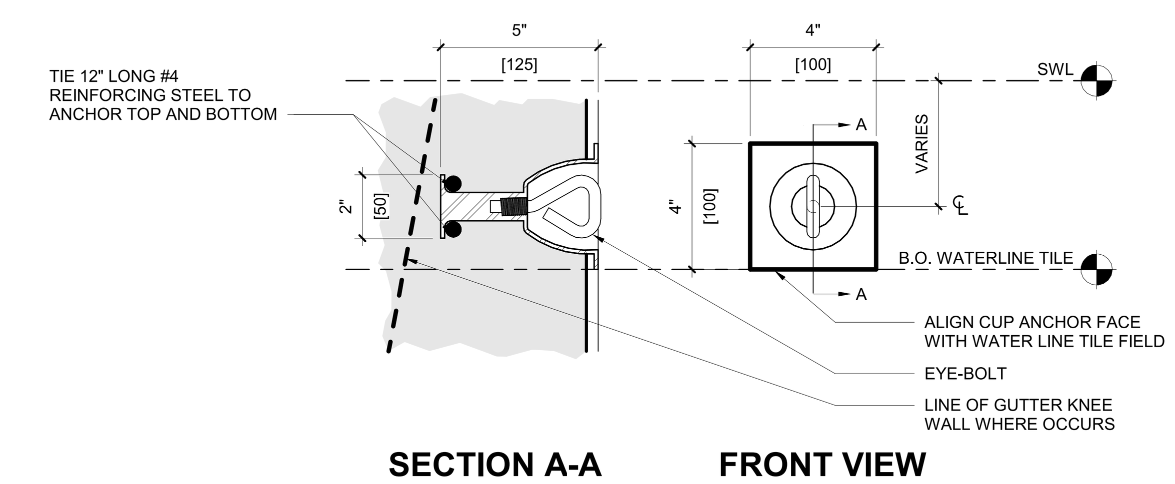
5 | ANCHOR - ROCKSOLID INSTALL
DETAIL VIEW
3/4" = 1'-0"



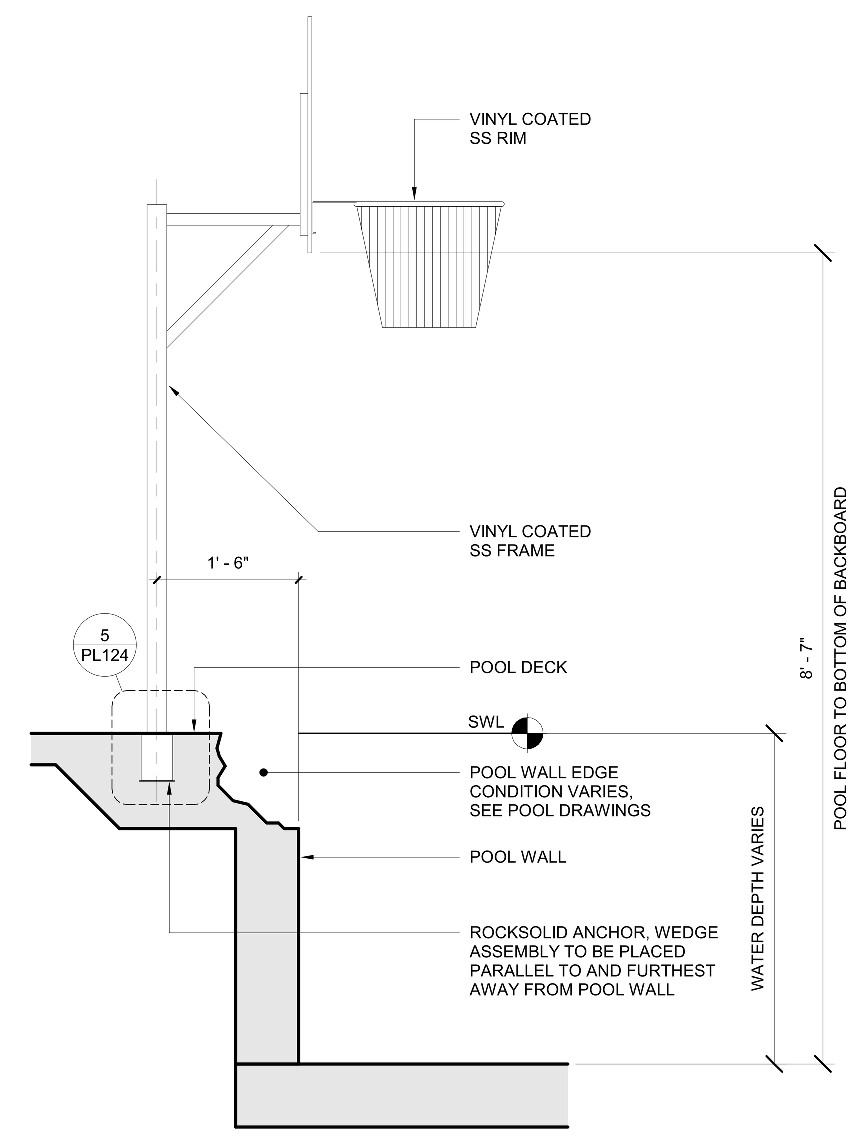
6 | ANCHOR - FLIP ANCHOR
DETAIL VIEW
3" = 1'-0"



1 | POOL WALL - 5'-0" WATER DEPTH AND ABOVE
DETAIL VIEW
1 1/2" = 1'-0"



2 | ANCHOR - ROPE CUP
DETAIL VIEW
3" = 1'-0"



NOTES:
1. CONCRETE CLEAR COVER AT ALL ANCHOR EMBEDMENTS SHALL BE 6" MINIMUM. THICKEN SLAB IF NECESSARY TO ACHIEVE MINIMUM COVER.

3 | ACTIVITIES - WATER BASKETBALL ANCHOR
DETAIL VIEW
3/4" = 1'-0"

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AquaZip'N®: A UNIQUE Poolside Adventure

With nothing like it on the market, AquaZip'N delivers poolside fun and excitement in a fresh new way. With this easy addition to your pool, you will drive demand from guests of all ages and increase your facility's programming capabilities on top of these benefits:

High Throughput

Launching riders into the water quickly, AquaZip'N keeps the line moving with a proprietary self-retracting trolley so kids can experience it again and again.

Minimal Footprint

AquaZip'N requires little deck space with its sleek frame that hangs out over the water and doesn't interfere with normal lap swimming. And with no water source required, it is an easy amenity to add.

Easy to Install

The AquaZip'N 3-piece system comes pre-fabricated for quick assembly and installation at your facility on any pool gutter configuration.

Position Anywhere

With a minimum water depth requirement of 4 feet, AquaZip'N can be added easily for thrilling poolside adventures in the shallow or deep end.

Activates the Deep End

As a safer alternative or enhancement to diving boards, AquaZip'N attracts tweens and teens to those under-utilized, deep areas of a pool.

100% Made in America

AquaZip'N is designed, engineered and manufactured in the USA to conform to all industry standards.

To learn how you can bring the adventure of AquaZip'N® to your facility, contact us today:

POOLSIDE ADVENTURES™

PoolsideAdventures.com | 800.956.6692 | info@PoolsideAdventures.com

Building Courageous Kids for Life's Great Adventure

AQUAZIP'N® SPECIFICATIONS

System Description

Deck mounted, overhead self-retracting pool rope swing. Components consist of Steel support structure, self retracting trolley system with handline. Manufactured off site. Designed to withstand chlorinated environments.

Components

Rope System

Rope system consists of a ⅝", 3-Strand Twisted, High Tenacity Polyester, Plied Yarn. High tenacity for durability, low stretch, superior UV resistance, excellent resistance to acids/chlorines. Attached to the Trolley using high density plastic connector and 3" stainless steel carabiner. See manufacturer's full specification for details.

Support Frame

The support frame shall be fabricated of 304 stainless steel sections powder coated in Glacier White, consisting of multiple bolt-together assemblies. The Frame height is 115" and maximum width of 39" with an overall length of 147" from back of structure to end of track.

Anchors

Anchors are to include either Hilti Chemical Anchors using Hilti HIT-HY 200 Adhesive—⅝" diameter or HAS-R stainless steel wedge anchor (or approved equivalent) with a 3-⅛" minimum embedment, (5qty anchors) per leg. Install anchors per manufacturer instruction.

Fasteners

All fixed connections: Bolts, Flat Washers, Nuts, are attached by grade 18-8 stainless steel or higher. Anchors will be 18-8 Stainless Steel or higher grade.

Trolley Cable Retraction Assembly

3⁄16" Dyneema 12-strand Cable

Warranty

AquaZip'N® is warrantied to the original purchaser to be free from defects in material and workmanship from the date of installation, during normal use and installation, with exclusions of cosmetic defects through wear and tear: Limited 2-Year Warranty

Design Recommendations

Deck & Gutter

The pool deck in the AquaZip'N® installation area should be as level as possible. If the pool has a coping greater than 1-½", or does not meet the standard base concrete requirements below, additional hardware components may be required. Please complete the Poolside Adventures™ Gutter Configuration Worksheet available on our website and contact a Poolside Adventures™ representative to determine the proper installation hardware and anchoring required.

Concrete Requirements

Standard length anchoring system requires a minimum concrete depth of 4" (with 6x6 W2.0 welded wire mesh ASTM A185) with 3000 psi rating or greater, embedded to a minimum depth of 3-⅛". See Hilti anchor requirements for further details. Further concrete requirements for proper installation includes a 4" thick, 6' wide (away from pool edge) of uninterrupted, un-cracked concrete slab section. Length (parallel with pool edge) of concrete slab can vary based on desired maximum rider weight:

- 8' long for 250 lbs rider load rating
- 7' long for 200 lbs rider load rating
- 6' long for 150 lbs rider load rating

Clearances & Safety Recommendations

Please contact a Poolside Adventures™ representative for current product information regarding pool depth and clearance zone recommendations based on the deck and configuration to be installed.

State certified engineered drawings and/or drawings specific to actual site installation details may be required for approval of AquaZip'N® installation. Standard structural engineering drawings are available at no charge. State or site-specific engineered drawings may be an additional cost. Please contact the appropriate local governing department for more information.

Poolside Adventures™ product guides, installation instructions, owner's maintenance guide and other resources are available at www.poolsideadventures.com or can be requested by calling 800-956-6692.

Operations Manual AquaZip'N

The new AquaZip'N design allows for minimal maintenance and high throughput. The following is the inspection checklist.

Daily Checklist:

- Ensure proper trolley retraction by rolling trolley out over water, letting go and watching to see that trolley returns to original starting location.
- Check trolley wheels and bearings visually to ensure trolley is secure within its track.
- Visibly check retraction cable for wear & tear.
- Cable stretch is normal. However, if you notice the weight is contacting the bottom of the baseplate it is time to replace your retraction cable. Call Poolside Adventures at 800-956-6692 to order a replacement.
- Visibly check the rubber bumpers on the front and back of the track to ensure they are firmly in place and there is no visible cracking or imperfections.
- Spray silicone-based lubricant onto all wheel bearings to increase the smoothness and longevity of your trolley system.

Monthly Checklist:

- Inspect trolley to ensure secure attachments of retraction cable to trolley.
- Inspect hand rope for wear & tear.
- Inspect rubber bumpers on the front and back of the track for any cracks or imperfections. If any are found, please call Poolside Adventures at 800-959-6692 to order replacements.
- Check retraction cable for wear & tear.
  - Cable stretch and wear is normal. If you notice any significant wear on your retraction cable or if the weight is contacting the bottom of the baseplate when in operation it is time to replace your retraction cable. Call Poolside Adventures at 800-956-6692 to order a replacement.
- Check all bolts on the AquaZip'N structure to ensure they are firm & tight.
- Be sure acorn nuts are firmly secure on all threads able to be reached from the ground.
- Anchor bolts shall be taught to specifications.
- Inspect safety pad for visible signs of wear including cracks and gouges.

Seasonal/Annual Checklist:

- Remove trolley from track to complete thorough trolley inspection, ensuring all bolts are firm and all wheels and bearings are in good shape.
- Over time the wheels and bearings will need to be replaced. Call Poolside Adventures at 800-956-6692 to order replacement wheels.
- Store trolley indoors, in a cool dry location, during the off-season.
- Inspect concrete surface for cracking and weathering to which the PSI of concrete could become compromised.

"A" FRAME SIGN TO BE DISPLAYED AT ALL TIME THE AQUAZIP'N IS IN USE

Calculation Report

Hand Calculation on Projectile Analysis & Forces on the user

PROJECT INFO.

Change History:

Version Number	Date	Prepared by	Reviewed by	Contact
V 1.0	5/3/2024	Bill Bin	Frank Wang	Frank.Wang@feamax.com

CFD Requestor Info.:

Contact name:	Alex Salzman
Email:	Alex@PoolsideAdventures.com
Company name:	PYRAMIDE USA INC.
Address:	PO Box 530. Frederick, MD 21705

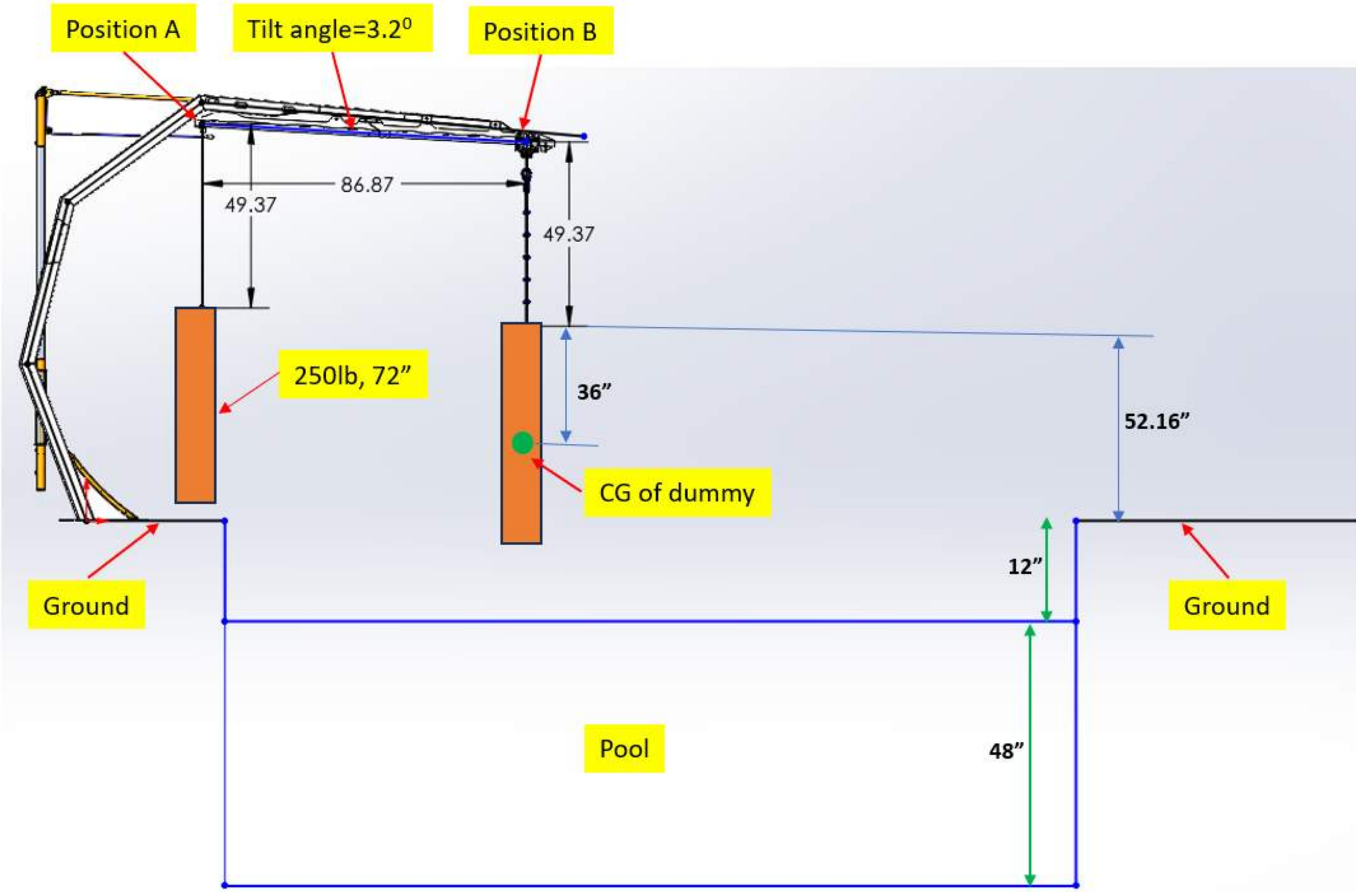
PROJECT DESCRIPTION

Project Description:

1. Perform hand calculations on the trolley system with the two cases.
2. The case #1 - Projectile Analysis: determine how far and how deep could a user go when launching from starting heights.
3. The case #2 - Forces on the user: determine the force on the user at beginning of ride and the end of ride.
4. The CAD model file for the calculation:
   - *Z0037C_V3.2 Master Assembly.SLDASM*
5. All related documents were received by 4/1/2024

CAD Model

1. The CAD model and the dimension information for calculation:



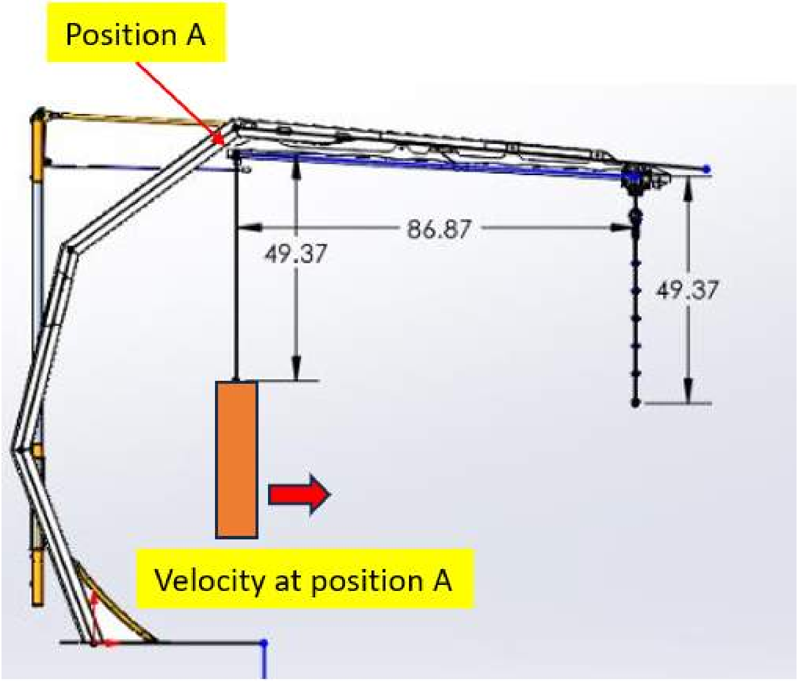
ASSUMPTIONS

Assumptions:

1. Assume a block/dummy on the rope with 250lbs mass and 6 feet height.
2. Assume the max jump forward distance is about 9.8 feet for a 250lbs adult from a standstill (worst case).
3. Considering the ideal condition, the person jumps at 45 degrees.
4. Assume it is frictionless contact at the top track rail.
5. Assume the 6 feet height dummy as a mass point at the CG (center of gravity).

Calculation of initial velocity

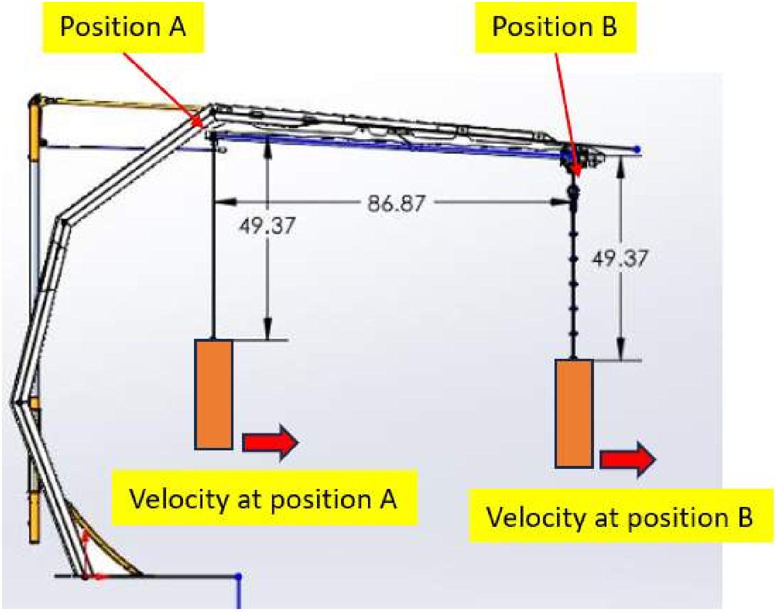
1. Equations:
   - V x T = L
   - V = g x t / 2
   - In which: V is velocity, T is time, L is the length and g is the acceleration.
2. We have V = sqrt(L x g / 2), in which: L= 9.8 ft, g = 32 ft/s2
3. The calculated results:
   - The initial velocity at position A = sqrt(L x g / 2) = 12.56 ft/s



CALCULATION RESULTS

Item#1 – Projectile Analysis

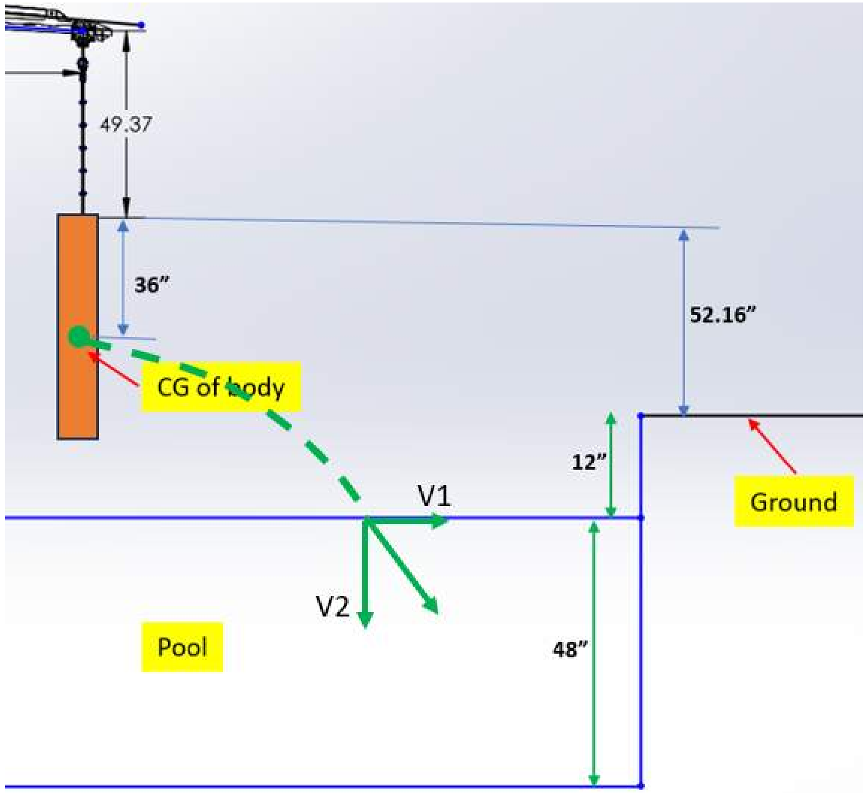
1. Calculation#1 –velocity at position B:
   - Because of the frictionless contact and the tilt angle is only about 3 degrees between position A and B, we could assume the velocity at position B is the same as or very close to position A.
   - The velocity at position B = 12.56 ft/s
2. Calculation#2 – the moving distance before touch the water:
   - The initial horizontal speed V = 12.56 ft/s
   - The height above water (from CG of body to water) = 52.16+12-36 = 28.16 inch
   - The time before touch water t = sqrt(2L /g) = sqrt(2x28.16/32.15) = 0.38 s
   - The vertical velocity V2 = g x t = 12.33 ft/s
   - The horizontal velocity V1 = 12.57 ft/s
   - The moving distance before touch the water L = V1 x t = 4.75 ft



CALCULATION RESULTS

Item#1 – Projectile Analysis

3. Calculation#3 – the moving depth and distance in the water:
    - Equation: $F_d = 1/2 \cdot Cd \cdot \rho \cdot A \cdot v^2$
    - where:
    - F_d is the drag force, C_d is the drag coefficient, ρ is the density of the fluid (water is approximately 1000 kg/m3), A is the cross-sectional area of the object perpendicular to the flow of fluid, v is the velocity of the object relative to the fluid.
    - The drag coefficient (C_d) and the cross-sectional area (A) depend on the shape and orientation of the human body in the water. We'll need to make assumptions to proceed.



CALCULATION RESULTS

Item#1 – Projectile Analysis

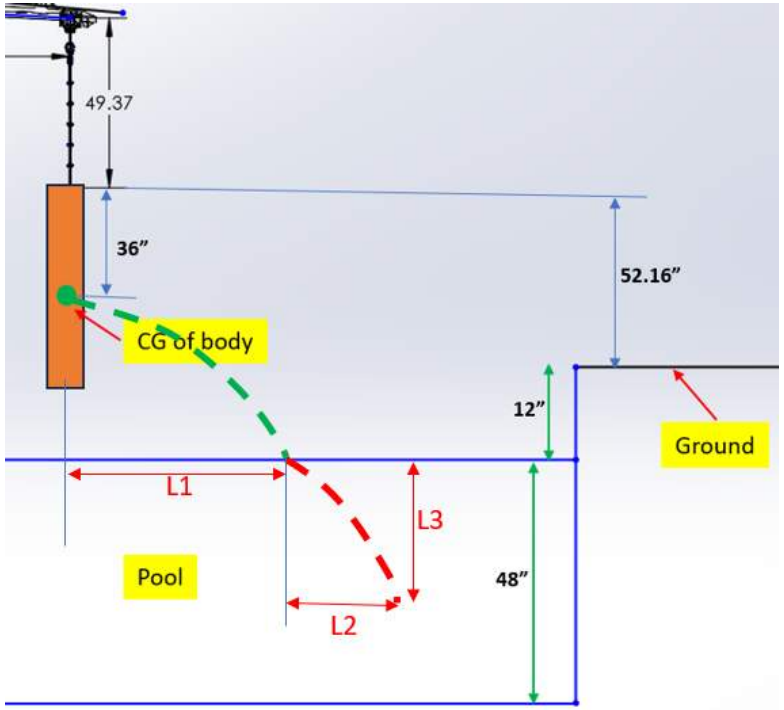
4. Calculation#4 – the moving depth and distance in the water:
   - The depth and horizontal distance can be determined by integrating the motion equations under the influence of gravity and drag. However, the actual calculations can be very complex due to the non-linear drag force that depends on the velocity squared.
   - Assume a constant average drag coefficient and ignoring buoyancy for the depth calculation, we can estimate the maximum depth and horizontal distance.
   - Assume Cd=1.0 for a body position that is neither perfectly streamlined nor fully perpendicular to the flow. Assume cross-section area A=0.1 m^2, which is a rough estimate for a human body.
   - Calculate the maximum depth and horizontal distance by considering the initial kinetic energy and the work done against the drag force. Distance = $\int_{V_i}^{0} \frac{1}{0.5Cd\rho Av} dv$ where v_i is the initial speed in the respective direction.
   - The calculated maximum depth and horizontal distance the human can reach in water are approximately 0.84 meters.
   - Note: these results are highly simplified. The actual values could differ significantly due to various factors such as the complex nature of drag in fluids, body orientation, and body shape effects.

CALCULATION RESULTS

Item#1 – Projectile Analysis

5. Calculation Results:

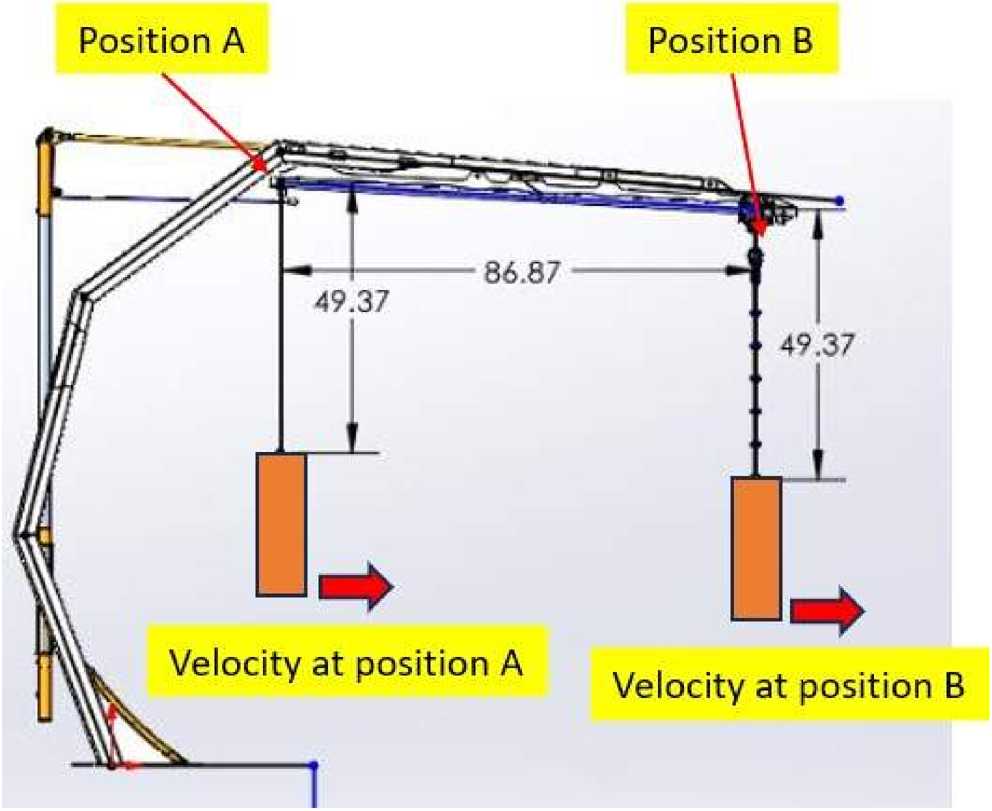
- Before touching the water, the body can move in horizontal direction L1 = 4.75 ft
- The max moving distance in horizontal direction in the water is about L2= 2.76 ft.
- The max depth in the water is about L3 = 2.76 ft.
- Note: if counting the body heigh 6ft, the max depth in the water would be 5.76 ft.



CALCULATION RESULTS

Item#2 – Forces on the user:

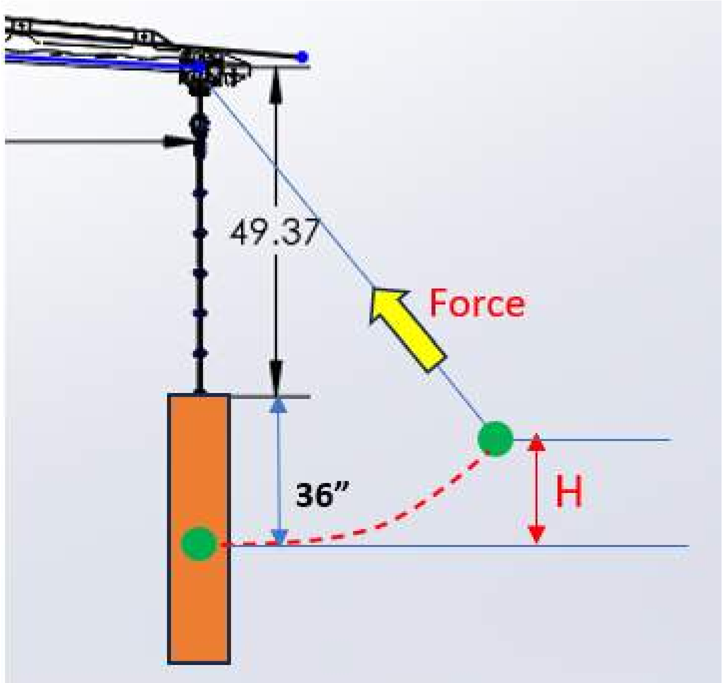
1. Calculation#1 – the max holding force on the user at position A:
   - Assume the body moves in horizontal direction, the initial holding force in vertical direction would be the same as the weight of user.
   - So, the max force on the user from rope at the beginning of ride (position A) is about 250 lbf.



CALCULATION RESULTS

Item#2 – Forces on the user:

2. Calculation#2 – the max holding force on the user at position B:
   - Assume the user would hold the rope without release.
   - The body would swing and cause higher force on the rope.
   - Max force $T_{max} = m \times g + m \times v^2 / r = 422$ Lbf.
   - The user swing height is about $H = V^2 / 2g = 2.43$ ft



3. Results:
   - The max force on the user (holding force on hands) from rope at the beginning of ride (position A) is about 250 Lbf.
   - The max force on the user (holding force on hands) from rope at the end of ride (position B) is about 422 Lbf.
   - The user can swing upward max height is about 2.43 ft.

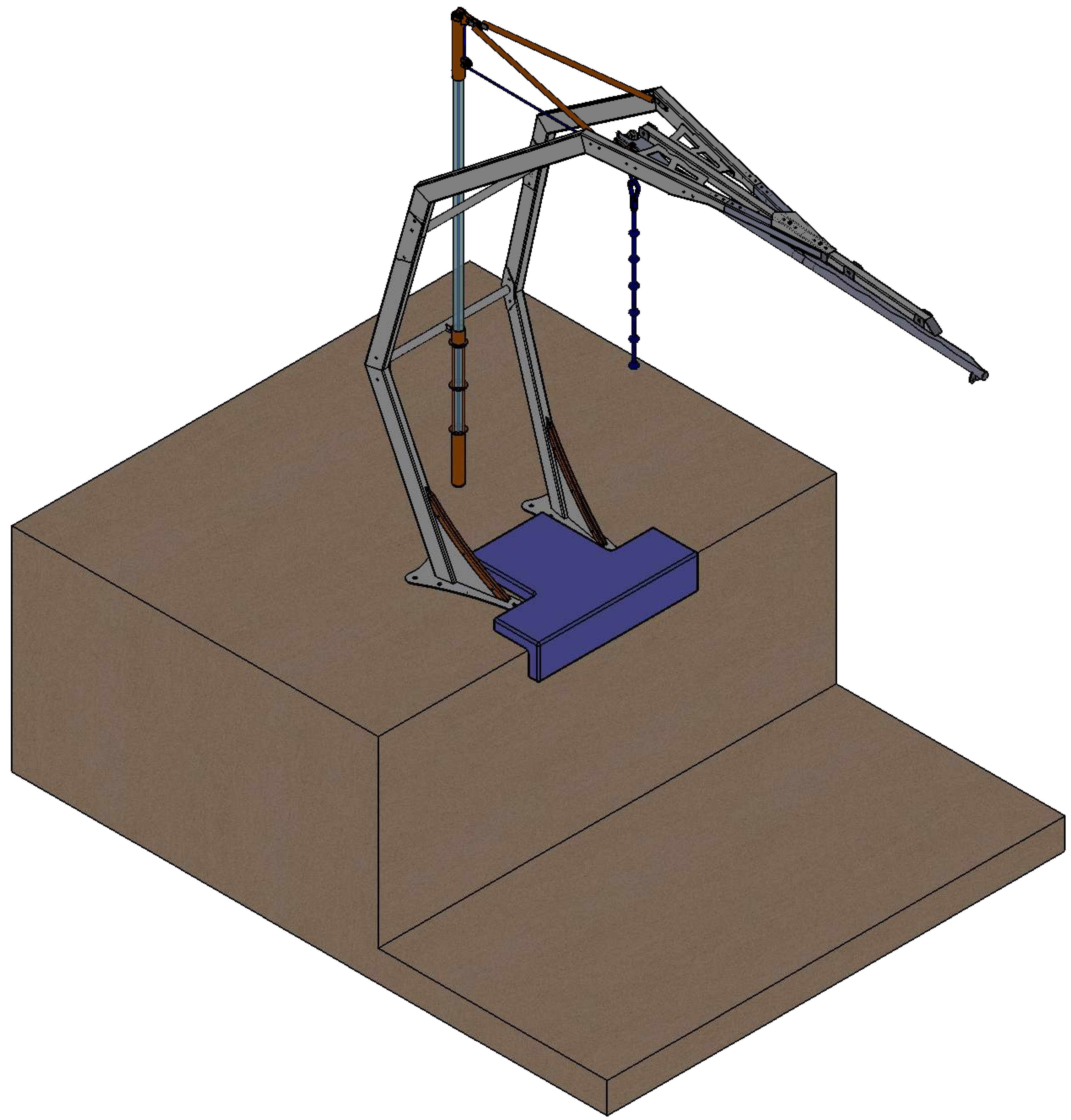
REVISIONS

REV.	DESCRIPTION	DATE	REV'D BY
A	Initial Release	7/27/2023	A. Salzman

Designed and engineered to the following standards:

- ASTM F2291-18 Amusement Rides and Devices
- ASTM F2461-18 Aquatic Play Equipment
- International Building Code (IBC) 2015 and ASCE 7, Minimum Design Loads for Building and Other Structures
- AISC Manual of Steel Contruction, 13th Edition
- ASD and Steel Design Guide 27 - Structural Stainless Steel

***Full structural analysis and stamped fabrication drawings available upon request



AquaZip'n V3.1 Architectural Guide

DESIGN

POOLSIDE ADVENTURES™

P.O. BOX 530
Frederick, MD 21705

PHONE: +1 800.956.6692
FAX: +1 240.575.6020
EMAIL: info@poolsideadventures.com

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Poolside Adventures
P.O. BOX 530
FREDERICK, MD 21705

UNLESS OTHERWISE SPECIFIED:
DIMENSIONS ARE IN INCHES [mm]
TOLERANCES:
FRACTIONAL ± 1/16
ANGULAR: MACH ± 1 BEND ± 1
TWO PLACE DECIMAL ± .03 [0.76]
THREE PLACE DECIMAL ± .005 [0.127]
DO NOT SCALE DRAWING

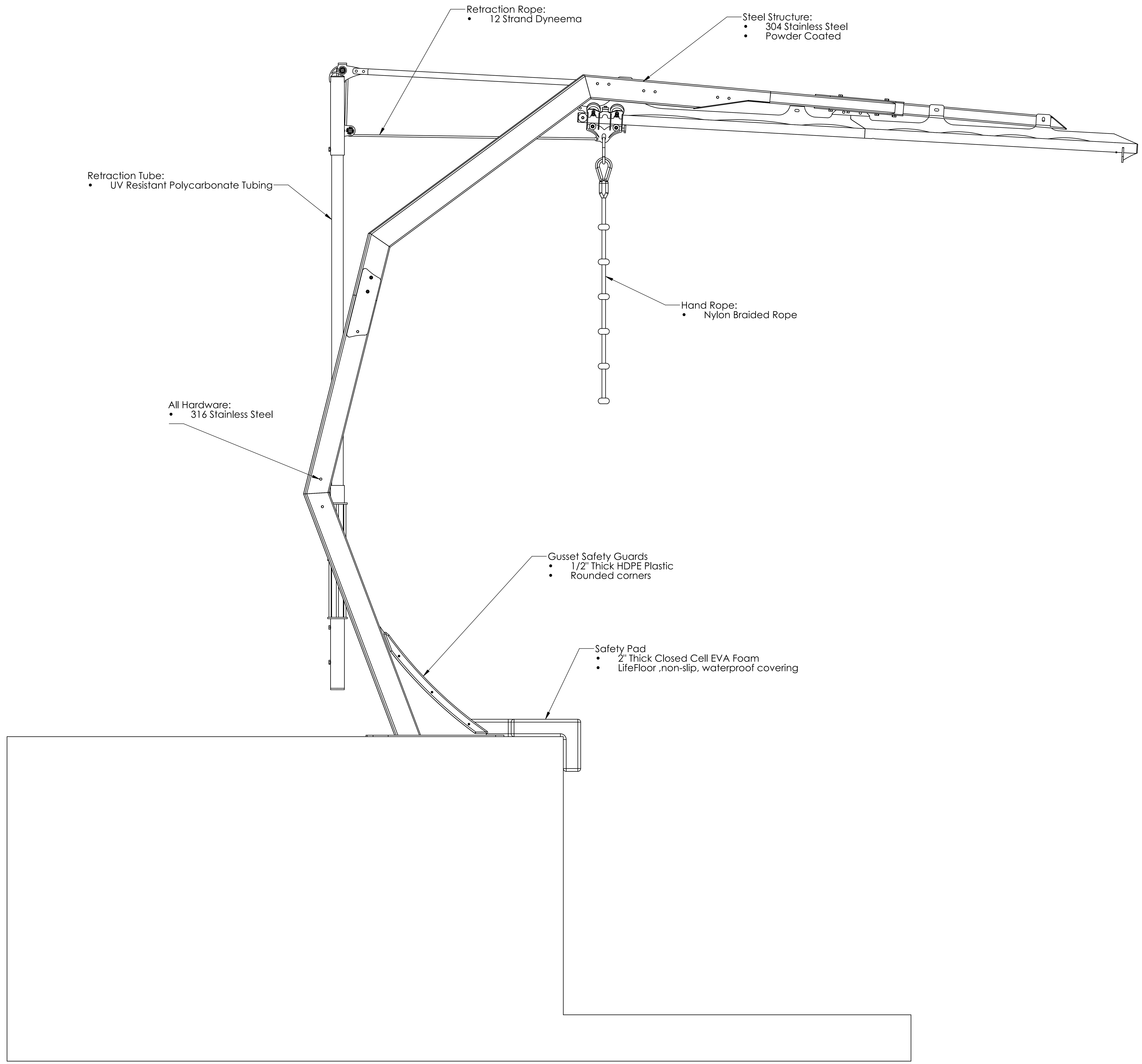
	NAME	DATE
DESIGNED		
DRAWN		
CHECKED		
ENGINEERED		

COMMENTS:
-NONE-

PROJECT:

TITLE:

SIZE	DWG. NO.	REV
D	Z0037C_V3.1 Architectural	
SCALE: 1:24	WEIGHT: 25799.23	SHEET 1 OF 7



Material Specs

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TWO PLACE DECIMAL ± .02 [0.51]
THREE PLACE DECIMAL ± .005 [0.127]
WELDS: $^{+1/16}_{-0}$

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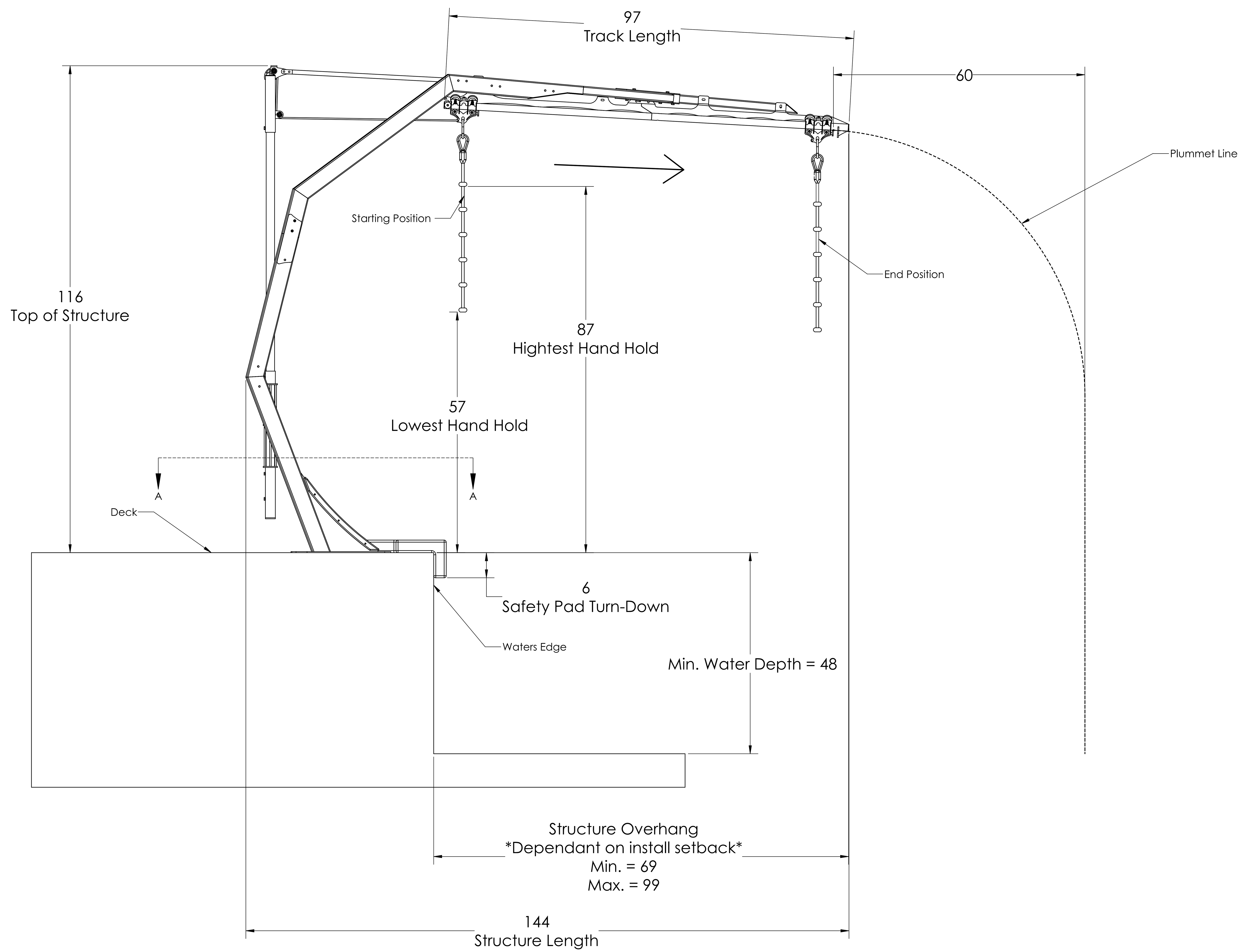
TITLE:

SIZE D | DWG. NO. Z0037C_V3.1 Architectural | REV

SCALE: 1:1 | WEIGHT: 25799.23 | SHEET 2 OF 7



Elevation View/Water Depth Req.

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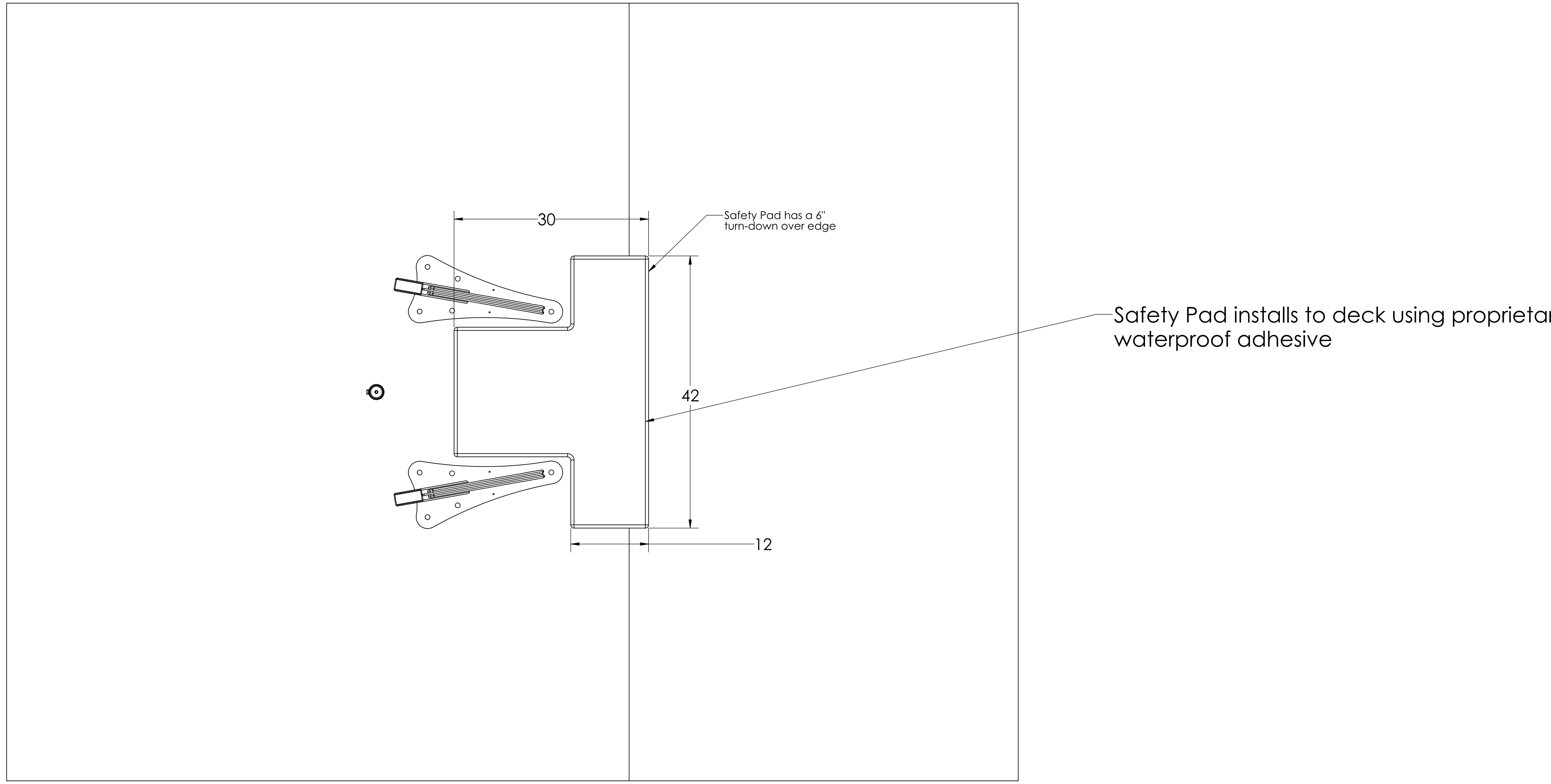
SIZE	DWG. NO.	REV
D	Z0037C_V3.1 Architectural	
SCALE: 1:1	WEIGHT: 25799.23	SHEET 3 OF 7



SECTION A-A
SCALE 1 : 10

Safety Pad Dimensions

***Custome safety pads available upon request
to work with any gutter system***

Safety Pad Details

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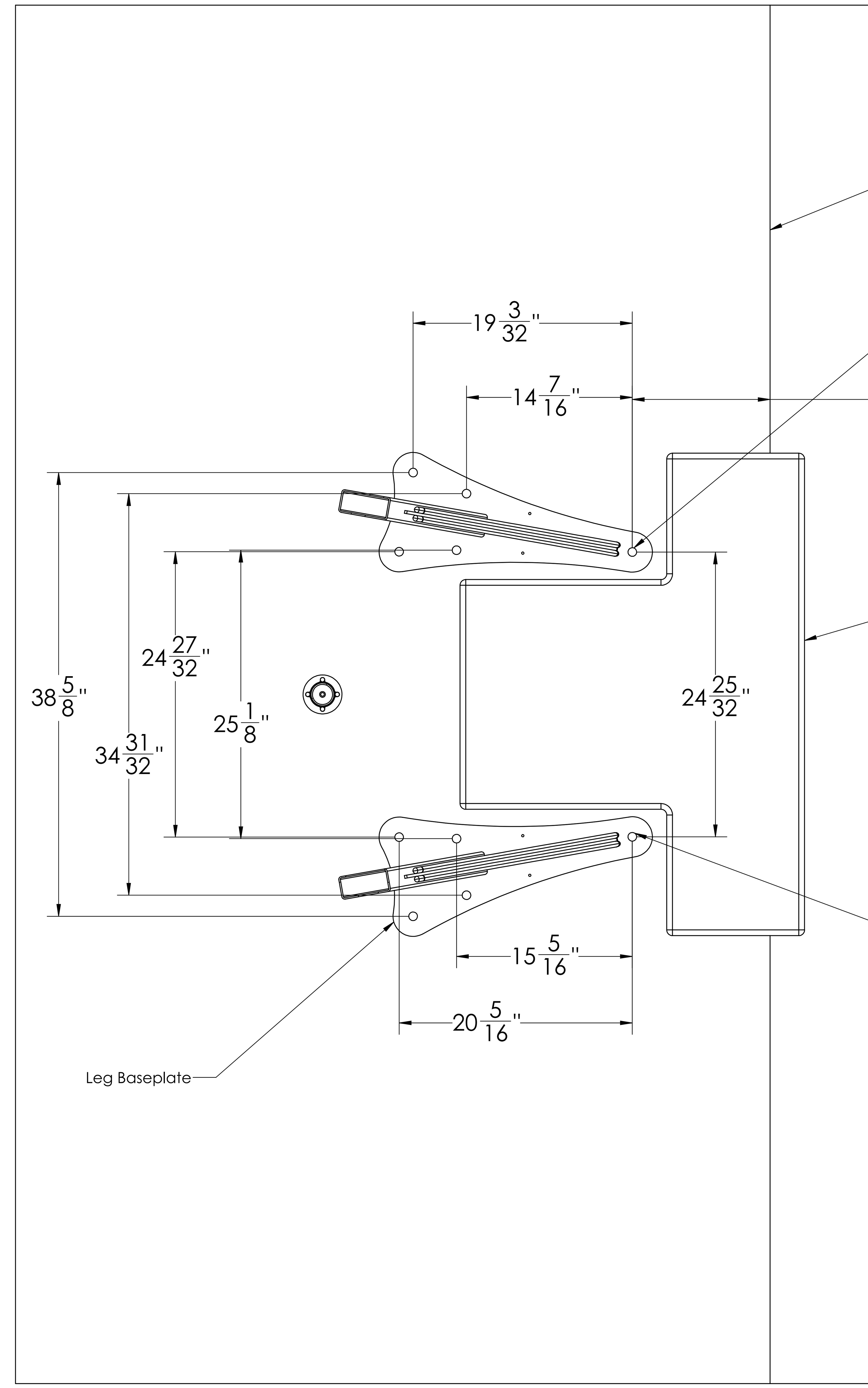
TITLE:

SIZE	DWG. NO.	REV
D	Z0037C_V3.1 Architectural	
SCALE: 1:1	WEIGHT: 25799.23	SHEET 4 OF 7



Anchoring Setback From Waters Edge
Min. = 12"
Max. = 40"

Safety Pad installs to deck using proprietary waterproof adhesive

Structure Anchoring:
(10x) 5/8" Concrete Wedge Anchors Supplied

***Alternative anchors can be provided upon request:
- flush mount anchors
- chemical anchors

SECTION A-A
SCALE 1 : 8

*****Anchor dimensions are for reference only, not to be used for installation. Anchor installation is done by using the Leg Baseplates themselves as drilling templates.*****

Anchoring Details

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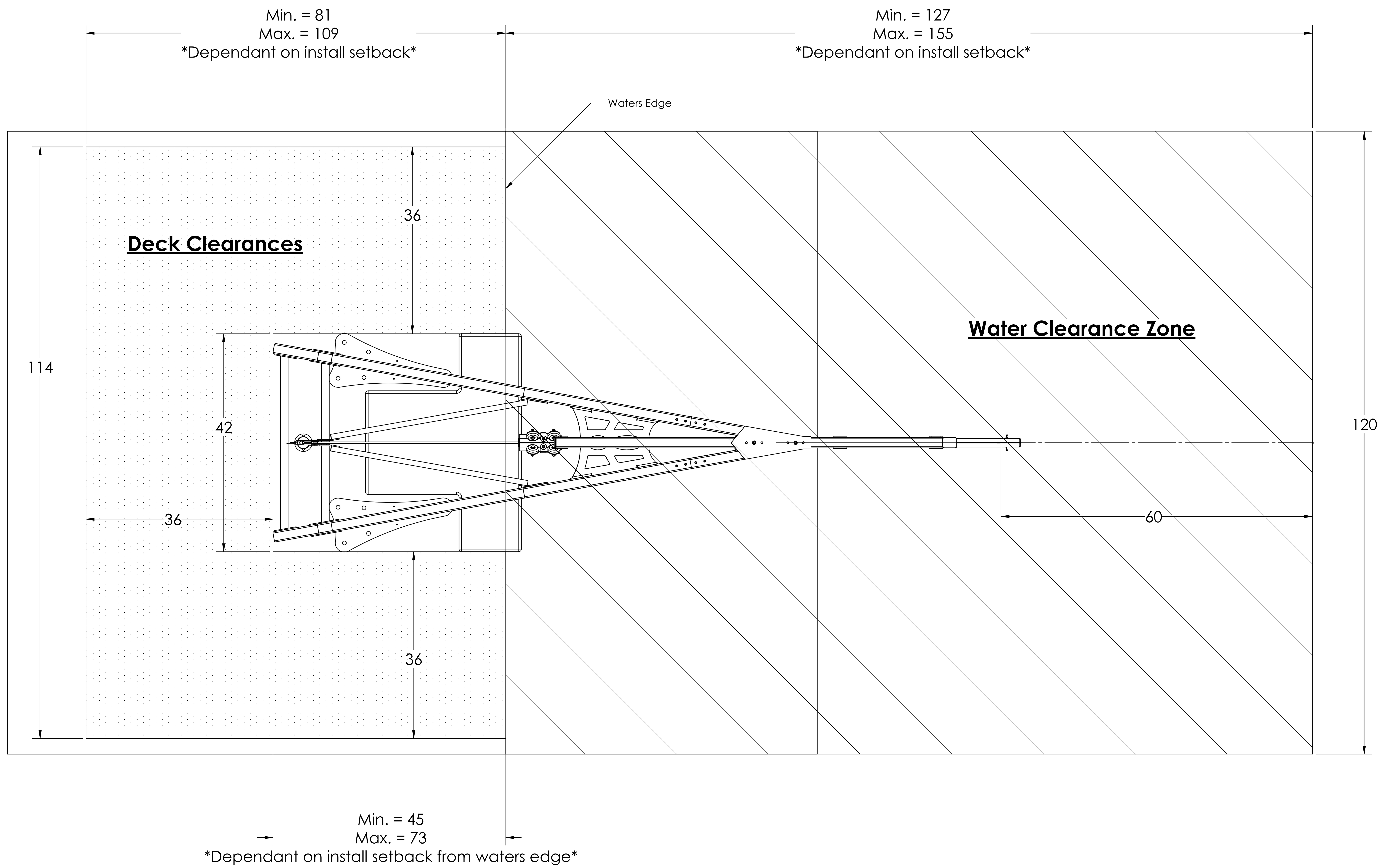
SCALE: 1:1	WEIGHT: 25799.23	SHEET 5 OF 7



Water and Deck Clearances

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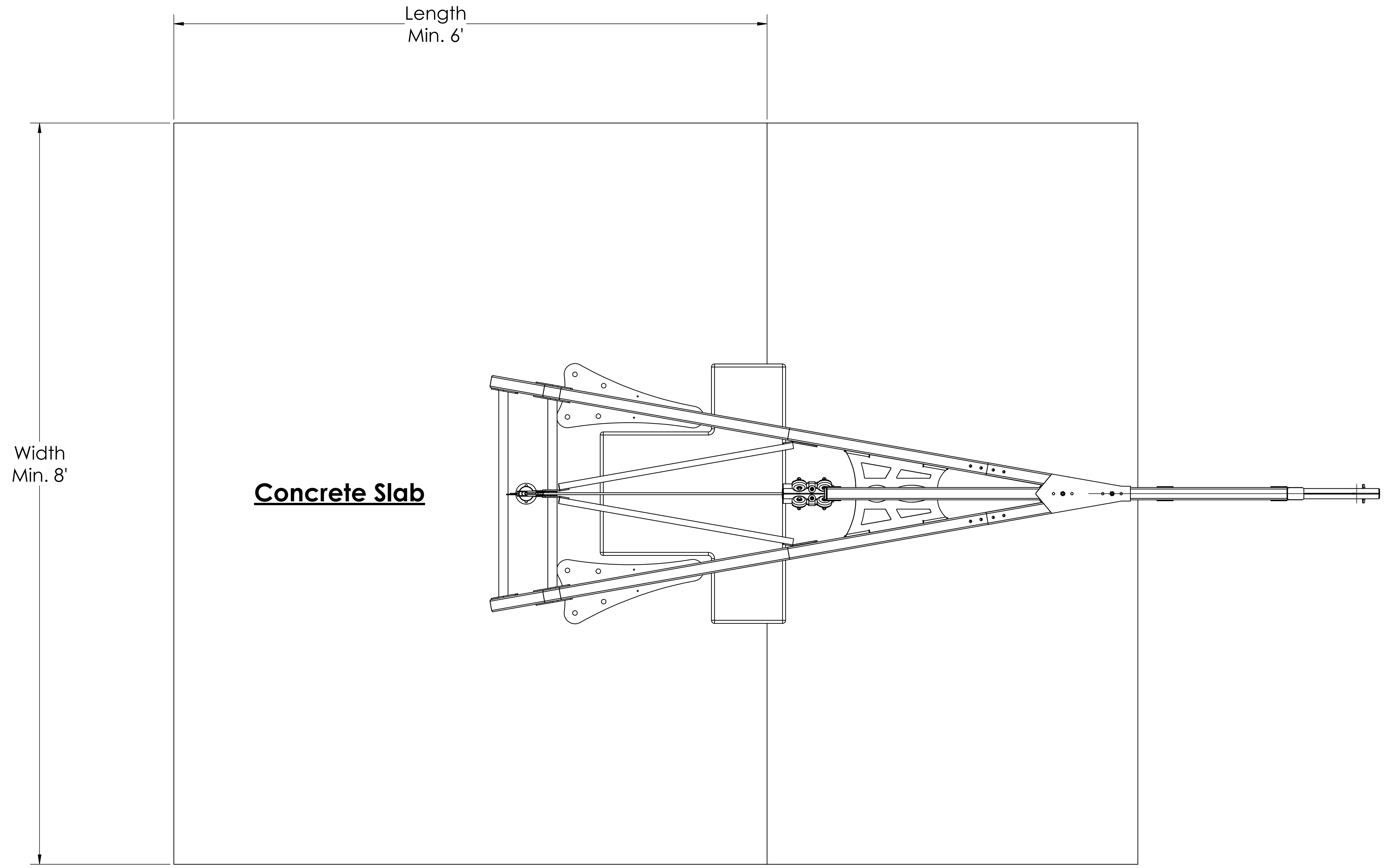
SCALE: 1:1	WEIGHT: 25799.23	SHEET 6 OF 7



Min. concrete thickness = 4"

Notes:
1. Location of front anchors no closer then 1' to front edge of pad.
2. Concrete dimensions shown are to acheive a min. required square footage. Alternative Lengths and widths can be accepted upon review.
3. Concrete width to be centered on AquaZip'n Frame.
4. Min. concrete thickness of 4" required, with 6x6 W2.0 welded wire mesh ASTM A185.
5. If concrete is new, minimum strength of 3000psi at 28 days is required.

Concrete Slab Requirements

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WELDS: $^{+1/16}_{-0}$

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FREDERICK, MD 21705

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SIZE	DWG. NO.	REV
D	Z0037C_V3.1 Architectural	
SCALE: 1:1	WEIGHT: 25799.23	SHEET 7 OF 7

NAC ARCHITECTURE

Patty Hayes, Board Chair
Washington State Board of Health
PO Box 47990
Olympia, WA 98504-7990

AQUATIC CENTER at MLK JR. PARK, Yakima

Variance Letter Date: 2024.06.20

STATE IDENTIFICATION: State ID Facility #: F0476 Project #:2024003

Facility Information:
Aquatic Center at MLK Jr. Park (New outdoor pool facility with 5,300sf pool building and two leisure pools)
Plan Submittal: Drawing Plans have been submitted for review.

Aquatic Center at MLK Jr. Park, City of Yakima

Owner Contact:	Ken Wilkinson	Phone: 509-576-6416
Owner Address:	129 N 2nd street	Yakima, WA 98901
Facility Address:	610 S 9th Street	Yakima, WA 98901
Owner Representative:	Brooke Hanley (NAC Architecture) 509-838-8240	

Variance Request Contact:
NAC Architecture: Brooke Hanley Phone: 509-838-8240 Email: bhanley@nacarchitecture.com

Variance Request Citation:
WAC 246-262-160 states *the board may grant a variance from requirements of chapter* ***246-262*** *WAC if, in the sole discretion of the board, data and/or research provides sufficient evidence that the RWCF (attraction, device, equipment, procedure, etc.), will adequately protect public health and safety, as well as water quality.*

Variance Request: Code language related to Diving Envelope (WAC 246-262-010(21) & WAC 246-262-060(5)(vi)) for the **NinjaCross Obstacle Course** attraction.

Items noted in review letter include:

- **NinjaCross Obstacle Course** attraction receiving pool shall conform to the CNCA or FINA standards (depth application and setbacks)

In the Department of Health review response letter issued by Justin Law dated May 22, 2024, Justin requests NAC Architecture (NAC) and WaterTechnology, Inc. (WTI) to address important concerns regarding public safety related to the receiving pool for the proposed **NinjaCross Obstacle Course** attraction in Pool B. The concern is to address the minimum depth of the pool to be compliant with the WAC 246-262-010(21) & WAC 246-262-060(5)(c)(vi) regarding diving envelopes for features where users enter the water from above the water surface.

On behalf of the City of Yakima, WA; NAC & WTI respectfully requests your consideration of the current pool depth design at the NinjaCross for the future Aquatic Center at MLK Jr. Park. To support this request we provide the attached information, engineering exhibits, and following commentary:

- The review letter states that the "diving envelope" from WAC 246-262-010(21) applies to **all attractions** where users enter above pool water level and therefore requires the CNCA (enter less than 20" above the water surface) or FINA (enter 20" or greater above the water surface) water depths. We submit that the attached independent engineering calculations for the **NinjaCross Obstacle Course** will demonstrate that the manufacturer's required water depths and the designed water depths provided at the Yakima Aquatic Center are sufficient to protect the safety of the users allowed to participate in this attraction. Calculations were completed for users ranging in height from 51" tall up to 72" tall, and weight ranging from 58lbs to 275lbs. The minimum user height is 48" and the maximum weight is 275lbs. The manufacturer's minimum depth requirement is 3'-6" feet depending on the obstacles purchased for the system. The current Yakima receiving pool water depth starts at 4'-0" at one end and slopes down to a depth of 5'-4" at the other end. Please review the attached engineering calculations in support of using the manufacturer's depth requirements in lieu of the CNCA or FINA diving envelope dimensions. See page 11 for a graphic section depicting an average user height compared and their position in or above the water using each obstacle. In the event that someone does drop from a height of 20" above the water, which is not anticipated for this attraction, the heaviest user would contact the pool floor feet-first with a force equivalent to contacting the ground after a 3.4" high jump on pavement. Quote from review letter, "The participant is expected to contact the pool bottom in a manner that is consistent with any shallow pool activities." The current design at the Yakima receiving pool exceeds these calculation assumptions by providing deeper water than the minimum required and will be lifeguarded to prevent people from incorrectly using the obstacles.

- WAC 246-262-060(5)(c)(vi) appears to apply specifically to "diving envelopes in pools or areas of pools <u>designated for diving activities</u>". The applicant submits that diving activities are generally defined as plunging into the water headfirst. Diving headfirst into water results in the need for deeper water to avoid a head & neck collision with the bottom of the pool which is different than a feet-first or tucked entry plunge where the body is significantly slowed in the first 2 feet of water. The **NinjaCross Obstacle Course** safety guidelines (provided in the exhibits) will note that users are required to enter the water in a feet-first manner. Diving from the unit is prohibited. The engineering calculations completed also assumes a feet-first plummet into the water. As users traverse the obstacles, they will generally have their feet dragging in the water and would not drop from a height above the water that is any different from stepping into the pool from the deck edge, see page 11.

- The Model Aquatic Health Code also addresses the complexity of "other aquatic features" like this and would suggest that the manufacturer recommendations for design and operation would be adequate to install the feature.

  4.12.10[A] Other Aquatic Features Other AQUATIC FEATURES not otherwise addressed in the CODE, including but not limited to climbing walls, inflatables, and play structures, shall not be installed unless designed and operated in accordance with all manufacturer's installation and operations recommendations.

- 'A-frame' signs with all written safety guidelines will be publicly displayed near the NinjaCross (see page 100 for example) to meet the criteria of WAC 246-262-070(10).

- Safety padding rated for falls from 6ft or less are provided around the base of the truss structure and down the face of the pool wall to prevent injuries at the corner of the gutter.

- This pool will be lifeguarded at all times while in operation and the lifeguard staff will be the first line of defense to screen bathers to make sure they are experienced swimmers, instruct swimmers on proper use of the attraction, and direct proper swimmer circulation to and from the activity within the pool to avoid congestion or collisions. The **NinjaCross** will have a dedicated lifeguard to closely supervise the safety of swimmers when the attraction is open for use.

- Injury statistics requested by the review letter are not available from the manufacturer or another source at this time, but many aquatic centers across the country are replacing their lily pad crossing activities with the NinjaCross obstacle course because it has been deemed safer than having the lily pads anchored to the floor and permanently obscuring the view of the water below the pads from lifeguard supervision. The NinjaCross obstacles do not have those same supervision issues.

- The **NinjaCross** has also been designed and engineered to meet the following standards: Where applicable, NinjaCross follows guidelines from the MAHC (model aquatic health code). As for ASTM, NinjaCross has registered their products as fitness/sporting goods equipment which fall under ASTM F2461-18 Section 1.3.8 Exclusions "1.3.8 Sports equipment, fitness equipment, and diving equipment." This system's patents and trademarks are registered under Sporting Goods & Fitness equipment and is not classified as an Amusement Ride.

- The City of Yakima specifically requested a pool design that would have a variety of intriguing activities for their patrons but would not need water deeper than 6-7ft. Pools deeper than 6-7ft come with their own safety risks and lifeguarding challenges. Shallow water is easier to supervise and guard. Rescues are much more likely to be needed in deep water where a bather in trouble cannot push off the bottom of the pool to bob back above the surface quickly until the lifeguard can assist them. Yakima is dedicated to making this facility fun while also as safe as possible for their community members and patrons.

- NAC submits that the design as described above and substantiated in the attached documentation meets the intent of providing a safe receiving pool for the **NinjaCross Obstacle Course** feature. NAC, WTI, and the City of Yakima respectfully requests a variance accordingly. If the State Board of Health has any follow-up conditions or actions required of the owner/operator, we are committed to implementing them.

NAC Architecture (NAC) has teamed with Water Technology (WTI) on numerous aquatic projects and so we have a history of producing these projects successfully. WTI has been designing Aquatic venues for over 40 years. WTI is widely known in the industry as one of the leading aquatic design firms in North America. As one of the industry's leaders, WTI has represented the waterpark industry during CPSC meetings on review of VGB rules and has also been involved in reviewing/editing sections of the MAHC. They are also represented in the Washington DOH committee to update the existing administrative code to adopt a more comprehensive aquatic code like the MAHC. The NAC and WTI commitment to safe aquatic facilities is proven. The design of the receiving pool at the **NinjaCross Obstacle Course** for the Yakima Aquatic Center will not put the health and safety of the public at risk. The City of Yakima, having operated a public pool for many years is experienced and committed to the safety and the welfare of their patrons.

On behalf of the City of Yakima, NAC Architecture would like to thank you for your consideration of this Variance Request. Please feel free to contact me with any questions you may have regarding this request.

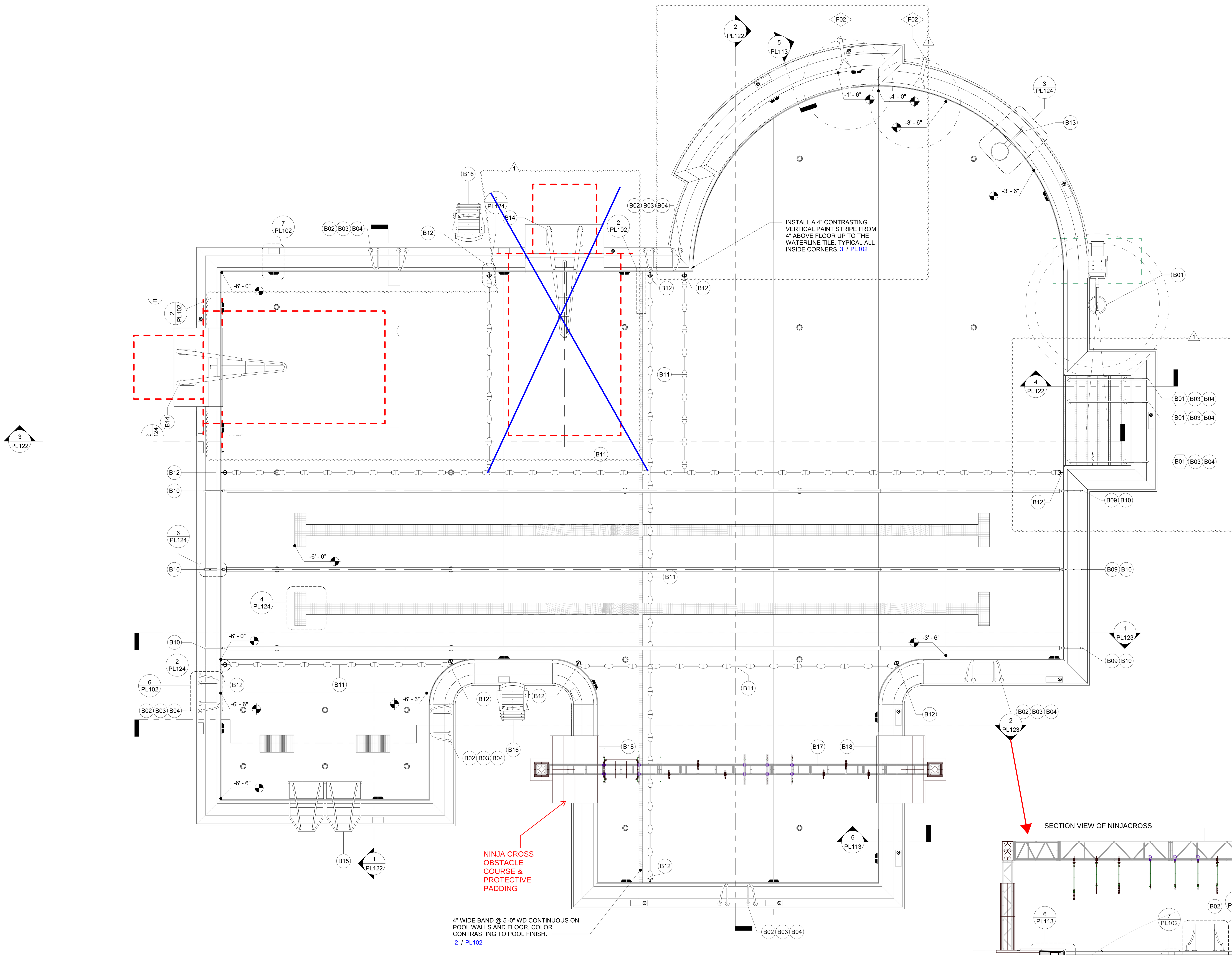
Thank you,

Brooke Hanley

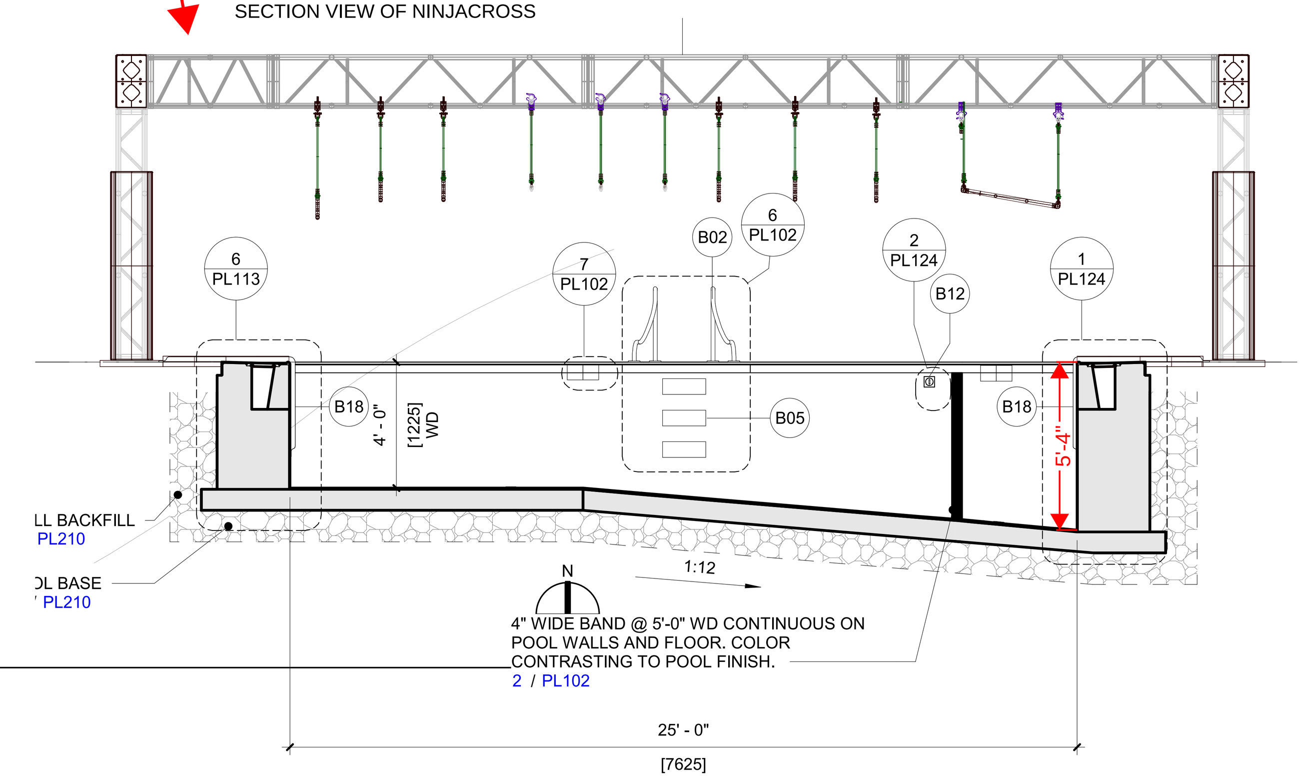
Brooke Hanley, AIA, Principal Architect, NAC Architecture

Attachments:

- NinjaCross Safety Information and Fall Zone Engineering, including a floor plan and section of the receiving pool for the Yakima Aquatic Center.



SECTION VIEW OF NINJACROSS



1 POOL B - ACTIVITY PLAN
PLAN VIEW
1/4" = 1'-0"

POOL B-ACTIVITY DATA

DESCRIPTION	QTY	UNITS	
POOL PERIMETER	314'-0"	FEET	
WATER SURFACE AREA	3,832	SQUARE FEET	
POOL WATER TEMPERATURE	84	°F	
POOL VOLUME	136,514	GALLONS	
SURGE TANK OPERATING VOLUME	7,415	GALLONS	
TOTAL VOLUME OF WATER	147,268	GALLONS	
CIRCULATION RATE	1,033	GPM	
TURNOVER/VOLUME/FLOW	60 MIN.	19,330 GAL.	322 GPM
TURNOVER/VOLUME/FLOW	180 MIN.	127,938 GAL.	711 GPM
FILTRATION RATE	12.66	GPM/FT²	
BACKWASH FLOW	306	GPM	
SURGE FACTOR	1.06	GAL/SQFT	
AVAILABLE SURGE CAPACITY IN SURGE TANK	4075	GALLONS	

SCHEDULE - BASIS OF DESIGN - POOL B

POOL ID	EQUIPMENT ID	EQUIPMENT	QTY	MANUFACTURER	DESCRIPTION
B	01	POOL LIFT	1	SR SMITH, AQUA CREEK, OR EQUAL	STANDARD ANCHORED, ROTATIONAL POOL LIFT, WITH 400 LB MINIMUM LIFTING CAPACITY. MUST MEET ALL APPLICABLE ADA REQUIREMENTS, WHILE MAINTAINING REQUIRED DECK CLEARANCE. PACKAGE TO INCLUDE ARMRESTS, ANCHOR, LIFT COVER, BATTERY CHARGER, AND CADDY
B	02	GRAB RAILS (PAIRS)	6	PARAGON AQUATICS, SPECTRUM AQUATICS, SR SMITH OR EQUAL	PRETZEL BEND STYLE, 1.50" OD x .120 WALL THICKNESS, 500 GRIT FINISH MIN.
B	03	ESCUTCHEON PLATE	34	PARAGON AQUATICS, SPECTRUM AQUATICS, SR SMITH OR EQUAL	STAINLESS STEEL ROUND ESCUTCHEON FOR 1.50" O.D. RAILS
B	04	WEDGE ANCHOR	34	PARAGON AQUATICS, SPECTRUM AQUATICS, SR SMITH OR EQUAL	CAST BRONZE, 4-1/4" LONG, ACCEPTS 1.500" OD TUBING
B	05	IN-WALL STEPS	18	PARAGON AQUATICS, SPECTRUM AQUATICS, SR SMITH OR EQUAL	17-1/2" x 6", INJECTION MOLDED PLASTIC, PEBBLE TEXTURE, 1/4" WALL THICKNESS
B	09	LANE DIVIDERS	3	COMPETITOR SWIM PRODUCTS	4" WAVE QUELLING RACING LANE LINE, COLORS BY OWNER / ARCHITECT
B	10	DalFLEX LANE LINE ANCHOR	6	DALDORADO	12" – NON-CORROSIVE PVC FLIP UP LANE LINE ANCHOR TO BE USED WITH DALDORADO PARALLEL GRATING. INCLUDES FLIP-UP HATCH, BASE UNIT, & SILICON COVERED SS BRAIDED STRAP EXTENSION WITH HOOK. CAN BE USED WITH THE DalFLEX 8" OR 14" LANE LINE EXTENSION.
B	11	SAFETY ROPE	6	PARAGON AQUATICS	3/4" POLYETHYLENE ROPE WITH 5"x9" HANDI-LOCK FLOAT, VERIFY LENGTH WITH PLANS
B	12	CUP ANCHOR	10	PARAGON AQUATICS, SPECTRUM AQUATICS, SR SMITH OR EQUAL	4" SQUARE 304L SS ANCHOR AND 304L SS EYE BOLT
B	13	BASKETBALL HOOP	1	SR SMITH	STAINLESS STEEL BASKETBALL HOOP WITH ROCKSOLID ANCHOR
B	14	AQUA ZIPN	1	AQUACLIMB	DECK-MOUNTED OVERHEAD ROPE SWING, WITH SELF-RETRACTING TROLLEY, POWDER-COATED STAINLESS STEEL WITH HIGH TENACITY POLYESTER ROPE. INCLUDES SAFETY PAD-UNIVERSAL, WITH 316 SS HILTI FLUSH MOUNT CONCRETE ANCHORS.
B	15	AQUACLIMB	1	AQUACLIMB	2 WIDE X 3 HIGH AQUATIC CLIMBING WALL
B	16	LIFEGUARD CHAIR	2	TAILWIND, KEIFER, SPECTRUM AQUATICS, SR SMITH OR APPROVED EQUAL	RECYCLED PLASTIC WITH 304 SS HARDWARE, COLOR BY OWNER/ARCHITECT 40" SEAT HEIGHT (OWNER'S SAFETY CONSULTANT TO SPECIFY LOCATION.)
B	17	NINJACROSS	1	NINJACROSS	AQUATIC OBSTACLE COURSE
B	18	SAFETY PAD	3	PLAYTIME	WALL AND DECK SAFETY PAD AT NINJACROSS SYSTEM

SCHEDULE - CUSTOM RAILGOODS - POOL B

POOL ID	EQUIPMENT ID	EQUIPMENT	QTY	MANUFACTURER	DESCRIPTION
B	01	HAND RAIL	3	PARAGON AQUATICS, SPECTRUM AQUATICS, SR SMITH OR EQUAL	CUSTOM FABRICATED, 316L SS, 1.50" OD x .120 WALL THICKNESS, 500 GRIT FINISH MIN.
B	02	HAND RAIL	2	PARAGON AQUATICS, SPECTRUM AQUATICS, SR SMITH OR EQUAL	CUSTOM FABRICATED, 316L SS, 1.50" OD x .120 WALL THICKNESS, 500 GRIT FINISH MIN.

SCHEDULE - WATER FEATURE - POOL B

POOL ID	FEATURE ID	FEATURE	QTY	MANUFACTURER	DESCRIPTION	GPM (ea)	GPM (Total)
~~B~~	~~F01~~	~~DROP SLIDE~~	~~1~~	~~SPLASHTACULAR~~	~~FUTURE SLIDE~~ PROVIDE PIPING CAPPED ONLY	~~500~~	~~500~~
B	F02	WATER SPRAY	2	WATERPLAY	PIPE DELUGE-FAN SPRAY FEATURE	60	120

REVISIONS

REV.NO.	DESCRIPTION	DATE
1	CHANGE PROPOSAL	04/16/2024

CONFORMED SET

CITY OF YAKIMA
YAKIMA POOL
YAKIMA WA

WTI WATER TECHNOLOGY INC.
World Leaders in Aquatic Planning, Design and Engineering
100 Park Avenue | Beaver Dam, WI 53916
t 920.887.7375

NAC ARCHITECTURE
nacarchitecture.com
1203 WEST RIVERSIDE AVENUE
SPOKANE WA 99201
P:509.838.8240

NAC NO 111-22082
ISSUE DATE: 4/16/24
PROJECT NUMBER: 22314
DRAWN BY: T.ED
CHECKED BY: ACC

7893 REGISTERED ARCHITECT
MATTHEW W. FREEBY
STATE OF WASHINGTON
4/16/2024

POOL B - ACTIVITY POOL PLAN

PL120

ECLIPSE ENGINEERING

June 12, 2024

Stephen Wagner
Director of Design & Development
NinjaCross™ Systems
stevew@ninjacrosssystems.com

Re: NinjaCross™ Drop Zone Assessment
Spokane Regional Health District
Project #2024-03-129

Stephen,

As requested, Eclipse Engineering has completed the drop zone assessment while using the NinjaCross™ System for the above noted jurisdiction. We utilized data from the CDC to determine the 10^{th}, 50^{th} and 90^{th} percentile for male and female children aged 10, 12, and 14 years old. Using these participants in addition to the maximum user weight for the system, we analyzed a variety of drop orientations into a pool depth of 3'6" from 20" above the surface of the pool, which is comparable to jumping into the water from the pool deck.

While considering the drop orientations from the available system obstacles, we concluded that a drop into the water while using the NinjaCross™ System per its intended use and safety standards would not present a life safety hazard from impacting the water's surface or contacting the pool floor. When a participant who is using the system per design drops from an obstacle, their acceleration stops when they contact the water's surface, and their velocity is significantly reduced within the first 24", thus allowing the participant to contact the pool floor without a sudden impact. The participant is expected to contact the pool bottom in a manner consistent with any shallow pool activities.

Please note that accidents and injuries can happen in any situation regardless of prevention measures put in place. It is the responsibility of the facility, staff, and local governing agencies to follow the operation and maintenance manuals of the NinjaCross™ system to ensure proper use. Eclipse Engineering does not guarantee the health and safety of any participant of a NinjaCross™ system or the facility itself.

Please contact us with any questions.

Sincerely,
Eclipse Engineering, PC

Digitally signed by Rolf Henry Armstrong
DN: E=rarmstrong@eeimt.com, CN=Rolf Henry Armstrong, O="Eclipse Engineering, P.C.", L=Bend, S=Oregon, C=US
Date: 2024.06.14 01:41:26-07'00'

ROLF ARMSTRONG
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39125
STRUCTURAL ENGINEER
PROFESSIONAL ENGINEER

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Attachment: Safe Drop Zone Graphic

ECLIPSE
ENGINEERING

STRUCTURAL CALCULATIONS

NinjaCross – Drop Zone Assessment

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Date: 2024.06.14 01:40:52-07'00'

Prepared For:

NinjaCross Systems
Kyle W. Rieger, CPO
kyle@ninjacrosssystems.com

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Assumptions

A. DENSITY OF PERSON IS 980 KG/M^3.

B. COEFFICIENT OF DRAG OF PERSON DROPPING THROUGH WATER IS 1.0.

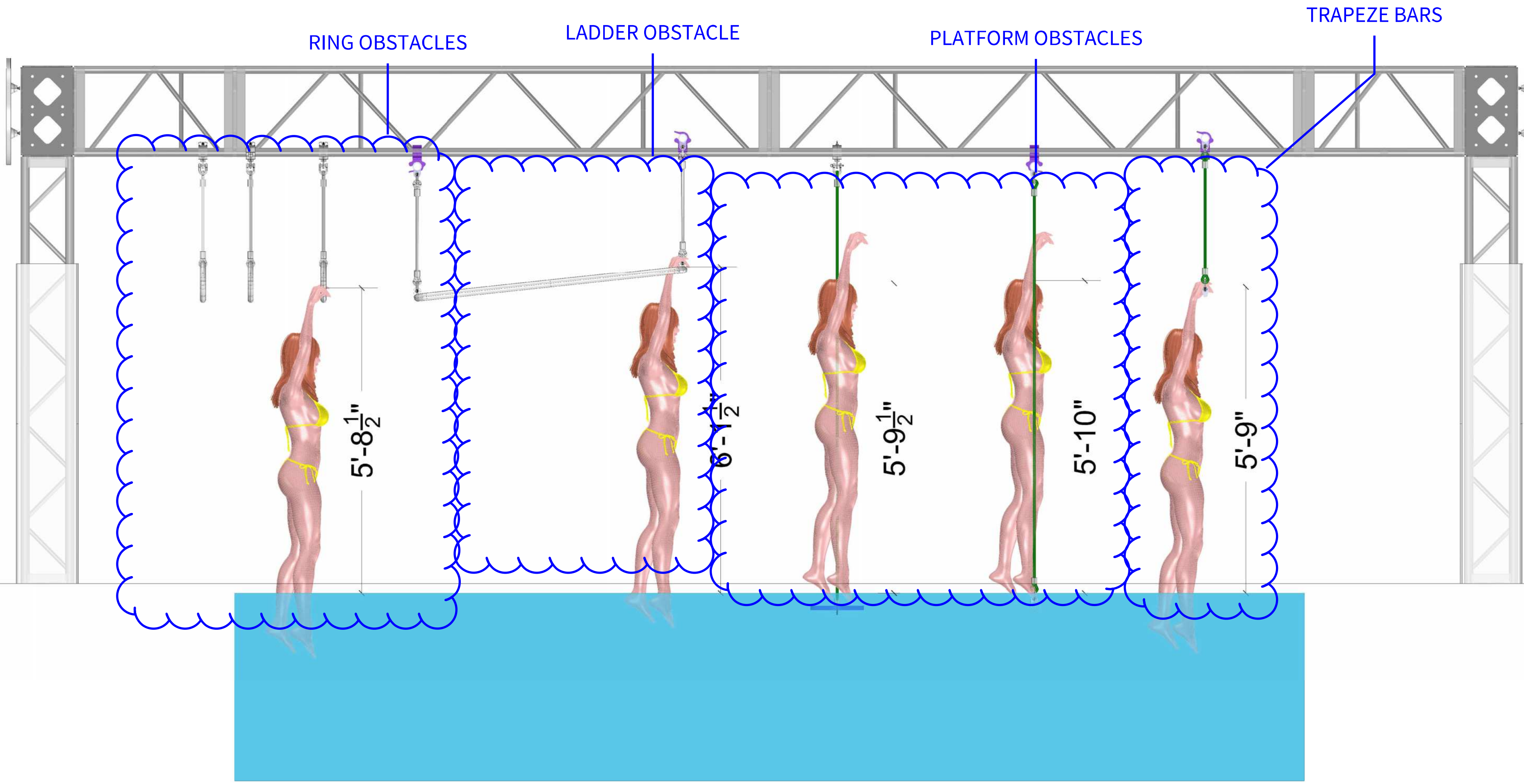
C. PERSON REMAINS STILL THROUGHOUT THE DROP UNTIL MAKING CONTACT WITH THE POOL FLOOR (IF APPLICABLE).

D. THE POOL DEPTH IS 3'-6".

E. PERSON DROPS WITH THEIR FEET 20 INCHES ABOVE THE TOP OF THE WATER.

F. PERSON DROPS FROM REST.

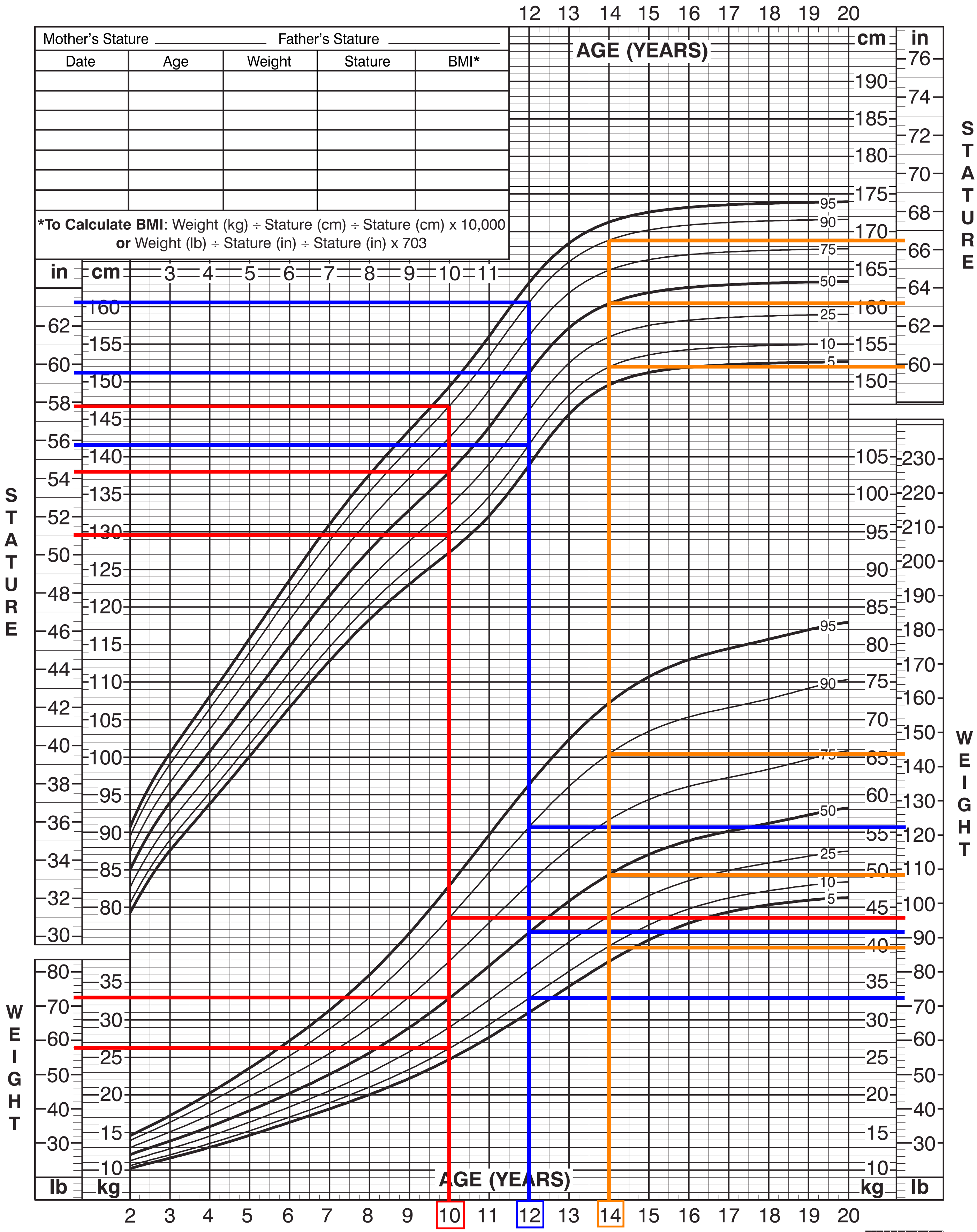
OBSTACLES AND USER CONDITIONS CONSIDERED IN EEPC FALL ZONE REVIEW
MINI NINJA SYSTEM



2 to 20 years: Girls
Stature-for-age and Weight-for-age percentiles

NAME ____________________

RECORD # __________



Published May 30, 2000 (modified 11/21/00).
SOURCE: Developed by the National Center for Health Statistics in collaboration with the National Center for Chronic Disease Prevention and Health Promotion (2000).
http://www.cdc.gov/growthcharts

CDC
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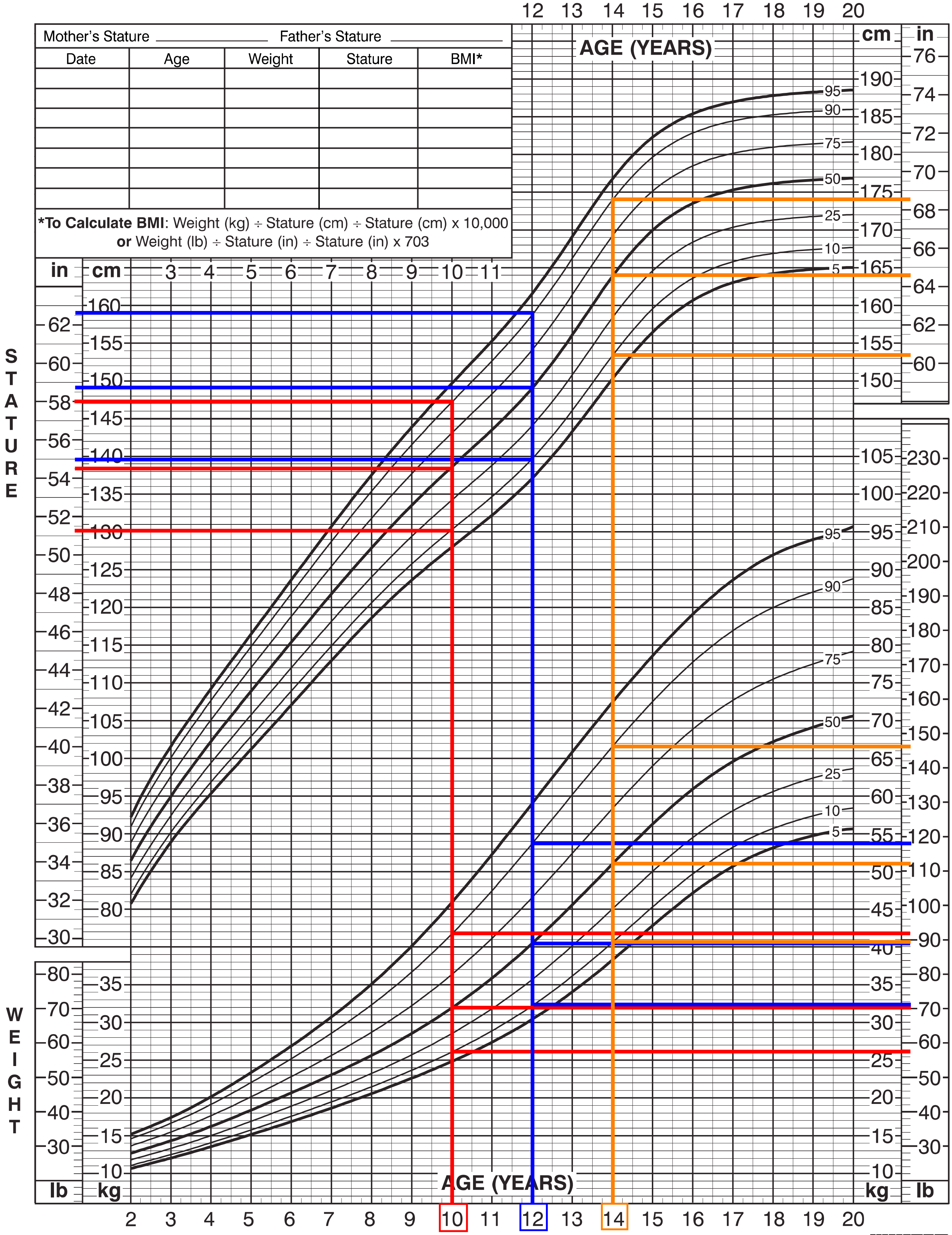
2 to 20 years: Boys
Stature-for-age and Weight-for-age percentiles

NAME ______________________________

RECORD # __________



Published May 30, 2000 (modified 11/21/00).

SOURCE: Developed by the National Center for Health Statistics in collaboration with the National Center for Chronic Disease Prevention and Health Promotion (2000).
http://www.cdc.gov/growthcharts

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Summary Data

Girls Stature & Weight for Age per CDC			
Age	Percentile	Weight (lb)	Height (in)
10	10	58	51
	50	72	54.5
	90	96	57.75
12	10	72	55.75
	50	92	59.5
	90	122	63.25
14	10	87	59.75
	50	108	63.25
	90	144	66.5

Boys Stature & Weight for Age per CDC			
Age	Percentile	Weight (lb)	Height (in)
10	10	58	51.25
	50	70	54.5
	90	92	58
12	10	71	55
	50	89	58.75
	90	118	62.75
14	10	89	60.5
	50	112	64.5
	90	146	68.5

NinjaCross System Design Participant	
Weight (lb)	Height (in)
275.0	72.0

NinjaCross System Design Participant Results				
	Vertical Drop	Diagonal Drop	Tucked Knee Drop	Horizontal Drop
Velocity at Pool Bottom	2.9 mph	2.9 mph	1.8 mph	0.0 mph
Effective Height of Drop	3.4 in	3.4 in	1.3 in	0.0 in

THE MAXIMUM VELOCITY AT WHICH THE PERSON HITS THE POOL FLOOR IS THAT WITH WHICH A PERSON HITS THE GROUND FROM A 3.4 INCH HEIGHT FALL.

$$mgh = \frac{1}{2}mv^2$$

Effective Height Above Ground $h = \dfrac{v^2}{2g}$

Please note that OSHA does not consider drops less than 4'-0" to require fall protection

Excerpt from https://www.osha.gov/fall-protection:
"OSHA requires that fall protection be provided at elevations of four feet in general industry workplaces."

Female Participant Results

Age	Percentile		Vertical Drop	Diagonal Drop	Tucked Knee Drop	Horizontal Drop
10	10	Velocity at Pool Bottom	0.0 mph	0.0 mph	0.0 mph	0.0 mph
		Effective Height of Drop	0.0 in	0.0 in	0.0 in	0.0 in
	50	Velocity at Pool Bottom	0.0 mph	0.0 mph	0.0 mph	0.0 mph
		Effective Height of Drop	0.0 in	0.0 in	0.0 in	0.0 in
	90	Velocity at Pool Bottom	1.3 mph	0.9 mph	0.0 mph	0.0 mph
		Effective Height of Drop	0.7 in	0.3 in	0.0 in	0.0 in
12	10	Velocity at Pool Bottom	0.0 mph	0.0 mph	0.0 mph	0.0 mph
		Effective Height of Drop	0.0 in	0.0 in	0.0 in	0.0 in
	50	Velocity at Pool Bottom	1.3 mph	0.7 mph	0.0 mph	0.0 mph
		Effective Height of Drop	0.7 in	0.2 in	0.0 in	0.0 in
	90	Velocity at Pool Bottom	2.5 mph	2.2 mph	0.0 mph	0.0 mph
		Effective Height of Drop	2.4 in	2.0 in	0.0 in	0.0 in
14	10	Velocity at Pool Bottom	0.9 mph	0.0 mph	0.0 mph	0.0 mph
		Effective Height of Drop	0.3 in	0.0 in	0.0 in	0.0 in
	50	Velocity at Pool Bottom	2.0 mph	1.8 mph	0.0 mph	0.0 mph
		Effective Height of Drop	1.6 in	1.3 in	0.0 in	0.0 in
	90	Velocity at Pool Bottom	2.9 mph	2.9 mph	0.0 mph	0.0 mph
		Effective Height of Drop	3.4 in	3.4 in	0.0 in	0.0 in

Male Participant Results

Age	Percentile		Vertical Drop	Diagonal Drop	Tucked Knee Drop	Horizontal Drop
10	10	Velocity at Pool Bottom	0.0 mph	0.0 mph	0.0 mph	0.0 mph
		Effective Height of Drop	0.0 in	0.0 in	0.0 in	0.0 in
	50	Velocity at Pool Bottom	0.0 mph	0.0 mph	0.0 mph	0.0 mph
		Effective Height of Drop	0.0 in	0.0 in	0.0 in	0.0 in
	90	Velocity at Pool Bottom	1.1 mph	0.4 mph	0.0 mph	0.0 mph
		Effective Height of Drop	0.5 in	0.1 in	0.0 in	0.0 in
12	10	Velocity at Pool Bottom	0.0 mph	0.0 mph	0.0 mph	0.0 mph
		Effective Height of Drop	0.0 in	0.0 in	0.0 in	0.0 in
	50	Velocity at Pool Bottom	1.1 mph	0.0 mph	0.0 mph	0.0 mph
		Effective Height of Drop	0.5 in	0.0 in	0.0 in	0.0 in
	90	Velocity at Pool Bottom	2.2 mph	2.0 mph	0.0 mph	0.0 mph
		Effective Height of Drop	2.0 in	1.6 in	0.0 in	0.0 in
14	10	Velocity at Pool Bottom	1.1 mph	0.0 mph	0.0 mph	0.0 mph
		Effective Height of Drop	0.5 in	0.0 in	0.0 in	0.0 in
	50	Velocity at Pool Bottom	2.2 mph	1.8 mph	0.0 mph	0.0 mph
		Effective Height of Drop	2.0 in	1.3 in	0.0 in	0.0 in
	90	Velocity at Pool Bottom	3.1 mph	2.9 mph	0.0 mph	0.0 mph
		Effective Height of Drop	3.9 in	3.4 in	0.0 in	0.0 in

NinjaCross System
Design Participant Calculations

Drops Vertically into the Pool

Height of COM	$h = 1.42$	m	
Mass of Person	$m = 124.72$	kg =	275 lb
Density of Water	$p_w = 1000.00$	kg/m^3	
Density of Person	$p_B = 980.00$	kg/m^3	
Cross-Sectional Area	$A = 0.19$	m^2 =	2 ft^2
Length of Person	$L = 1.83$	m =	6 ft
Volume of Person	$V = 0.33$	m^3	
Coefficient of Drag	$C_D = 1.00$		
Gravitational Constant	$g = 9.81$	m/s^2	

Drag Force Equation $$F_D = \frac{1}{2} C_D A p_w v^2$$

Bouyancy Equation $$F_B = Vg(p_w - p_B)$$

Initial Conditions		
t_o =	0	s
v_o =	3.157	mph

ELAPSED TIME (s)	**VELOCITY AT TIME (mph)**	DRAG FORCE (N)	BOUYANCY FORCE (N)	NET FORCE (N)	DISTANCE (m)	**TOTAL DEPTH (ft)**
0	**7.1**				0.0	**0.0**
0.100	5.7	624.2	10.0	-634.2	0.29	0.9
0.200	4.7	432.1	18.2	-450.3	0.52	1.7
0.300	4.1	314.2	25.1	-339.3	0.72	2.4
0.400	3.5	236.3	31.0	-267.3	0.89	2.9
0.500	3.1	182.0	36.2	-218.1	1.04	3.4
0.600	2.7	142.4	40.8	-183.1	1.17	3.8
0.700	2.4	112.6	44.8	-157.4	1.28	4.2
0.800	2.2	89.6	48.4	-138.0	1.39	4.5
0.900	1.9	71.5	51.6	-123.1	1.48	4.9
1.000	1.7	56.9	54.5	-111.4	1.56	5.1
1.100	1.5	45.1	57.1	-102.2	1.63	5.4
1.200	1.4	35.4	59.4	-94.8	1.70	5.6
1.300	1.2	27.5	61.4	-88.9	1.76	5.8
1.400	1.0	20.9	63.2	-84.1	1.81	5.9
1.500	0.9	15.5	64.7	-80.2	1.85	6.1
1.600	0.8	11.1	66.0	-77.1	1.89	6.2
1.700	0.6	7.5	67.1	-74.6	1.92	6.3
1.800	0.5	4.7	68.0	-72.7	1.95	6.4
1.900	0.4	2.6	68.6	-71.2	1.96	6.4
1.980	0.3	1.4	69.0	-70.4	1.98	6.5
2.000	0.2	1.1	69.1	-70.3	1.98	6.5
2.100	0.1	0.3	69.4	-69.7	1.99	6.5

Drops Diagonally into the Pool

Height of COM	$h = 1.15$	m	
Mass of Person	$m = 124.72$	kg =	275 lb
Density of Water	$p_w = 1000.00$	kg/m^3	
Density of Person	$p_B = 980.00$	kg/m^3	
Cross-Sectional Area	$A = 0.19$	m^2 =	2 ft^2
Length of Person	$L = 1.29$	m =	4.24264069 ft
Volume of Person	$V = 0.33$	m^3	
Coefficient of Drag	$C_D = 1.00$		
Gravitational Constant	$g = 9.81$	m/s^2	

Drag Force Equation $$F_D = \frac{1}{2} C_D A p_w v^2$$

Bouyancy Equation $$F_B = Vg(p_w - p_B)$$

Initial Conditions		
t_o =	0	s
v_o =	3.157	mph

ELAPSED TIME (s)	**VELOCITY AT TIME (mph)**	DRAG FORCE (N)	BOUYANCY FORCE (N)	NET FORCE (N)	DISTANCE (m)	**TOTAL DEPTH (ft)**
0	**7.1**				0.0	**0.0**
0.100	5.7	623.6	14.1	-637.7	0.29	0.9
0.200	4.7	430.1	25.7	-455.8	0.52	1.7
0.300	4.0	310.8	35.4	-346.2	0.72	2.3
0.400	3.5	231.6	43.7	-275.3	0.88	2.9
0.500	3.0	176.1	51.0	-227.1	1.03	3.4
0.600	2.7	135.5	57.3	-192.8	1.16	3.8
0.700	2.3	104.9	62.9	-167.8	1.27	4.2
0.800	2.1	81.3	67.7	-149.0	1.37	4.5
0.900	1.8	62.7	72.1	-134.7	1.46	4.8
1.000	1.6	47.8	75.8	-123.6	1.53	5.0
1.100	1.4	35.9	79.1	-115.0	1.60	5.3
1.200	1.2	26.3	81.9	-108.2	1.66	5.4
1.300	1.0	18.6	84.3	-102.9	1.71	5.6
1.400	0.8	12.5	86.3	-98.8	1.75	5.7
1.500	0.6	7.7	87.9	-95.6	1.78	5.8
1.600	0.5	4.2	89.1	-93.3	1.80	5.9
1.700	0.3	1.8	90.0	-91.8	1.82	6.0
1.800	0.1	0.4	90.5	-90.9	1.83	6.0
1.900						
1.980						
2.000						
2.100						

Drops with Tucked Knees into the Pool

Height of COM	h = 0.97	m	
Mass of Person	m = 124.72	kg =	275 lb
Density of Water	p_w = 1000.00	kg/m^3	
Density of Person	p_B = 980.00	kg/m^3	
Cross-Sectional Area	A = 0.28	m^2 =	3 ft^2
Length of Person	L = 0.91	m =	3 ft
Volume of Person	V = 0.33	m^3	
Coefficient of Drag	C_D = 1.00		
Gravitational Constant	g = 9.81	m/s^2	

Drag Force Equation $$F_D = \frac{1}{2} C_D A p_w v^2$$

Bouyancy Equation $$F_B = Vg(p_w - p_B)$$

Initial Conditions		
t_o =	0	s
v_o =	3.157	mph

ELAPSED TIME (s)	**VELOCITY AT TIME (mph)**	DRAG FORCE (N)	BOUYANCY FORCE (N)	NET FORCE (N)	DISTANCE (m)	**TOTAL DEPTH (ft)**
0	**7.1**				0.0	**0.0**
0.100	5.2	783.8	19.1	-802.9	0.27	0.9
0.200	4.0	475.9	33.5	-509.4	0.48	1.6
0.300	3.3	313.5	45.0	-358.5	0.64	2.1
0.400	2.7	216.6	54.5	-271.1	0.78	2.6
0.500	2.3	153.9	62.4	-216.3	0.89	2.9
0.600	2.0	110.7	69.1	-179.9	0.99	3.2
0.700	1.7	79.8	74.8	-154.7	1.07	3.5
0.800	1.4	57.0	79.7	-136.7	1.14	3.7
0.900	1.2	39.9	83.7	-123.6	1.20	3.9
1.000	1.0	26.9	87.1	-114.0	1.25	4.1
1.100	0.8	17.2	89.8	-107.0	1.29	4.2
1.200	0.6	9.9	91.9	-101.9	1.32	4.3
1.300	0.4	4.9	93.5	-98.4	1.34	4.4
1.400	0.2	1.7	94.5	-96.1	1.35	4.4
1.500	0.1	0.1	95.0	-95.1	1.36	4.5
1.600						
1.700						
1.800						
1.900						
1.980						
2.000						
2.100						

Drops Horizontally into the Pool

Height of COM	h = 0.81	m	
Mass of Person	m = 124.72	kg =	275 lb
Density of Water	p_w = 1000.00	kg/m^3	
Density of Person	p_B = 980.00	kg/m^3	
Cross-Sectional Area	A = 0.56	m^2 =	6 ft^2
Length of Person	L = 0.61	m =	2 ft
Volume of Person	V = 0.33	m^3	
Coefficient of Drag	C_D = 1.00		
Gravitational Constant	g = 9.81	m/s^2	

Drag Force Equation $$F_D = \frac{1}{2} C_D A p_w v^2$$

Bouyancy Equation $$F_B = V g (p_w - p_B)$$

Initial Conditions		
t_o =	0	s
v_o =	3.157	mph

ELAPSED TIME (s)	**VELOCITY AT TIME (mph)**	DRAG FORCE (N)	BOUYANCY FORCE (N)	NET FORCE (N)	DISTANCE (m)	**TOTAL DEPTH (ft)**
0	**7.1**				0.0	**0.0**
0.100	4.0	985.0	25.4	-1010.4	0.24	0.8
0.200	2.8	463.1	41.3	-504.4	0.39	1.3
0.300	2.1	259.2	52.8	-312.0	0.50	1.7
0.400	1.6	157.4	61.6	-219.1	0.59	1.9
0.500	1.3	99.1	68.6	-167.7	0.65	2.1
0.600	1.0	62.6	74.1	-136.7	0.71	2.3
0.700	0.8	38.6	78.5	-117.0	0.75	2.5
0.800	0.6	22.4	81.8	-104.2	0.78	2.6
0.900	0.4	11.5	84.3	-95.8	0.80	2.6
1.000	0.3	4.6	86.0	-90.6	0.82	2.7
1.100	0.1	0.9	87.0	-87.9	0.83	2.7
1.200						
1.300						
1.400						
1.500						
1.600						
1.700						
1.800						
1.900						
1.980						
2.000						
2.100						

10-year-old Girl Calculations

Drops Vertically into the Pool

Height of COM	h = 1.16	m	
Mass of Person	m = 26.30	kg =	58 lb
Density of Water	p_w = 1000.00	kg/m^3	
Density of Person	p_B = 980.00	kg/m^3	
Cross-Sectional Area	A = 0.09	m^2 =	1 ft^2
Length of Person	L = 1.30	m =	4.25 ft
Volume of Person	V = 0.33	m^3	
Coefficient of Drag	C_D = 1.00		
Gravitational Constant	g = 9.81	m/s^2	

Drag Force Equation $$F_D = \frac{1}{2} C_D A p_w v^2$$

Bouyancy Equation $$F_B = Vg(p_w - p_B)$$

Initial Conditions		
t_o =	0	s
v_o =	3.157	mph

ELAPSED TIME (s)	**VELOCITY AT TIME (mph)**	DRAG FORCE (N)	BOUYANCY FORCE (N)	NET FORCE (N)	DISTANCE (m)	**TOTAL DEPTH (ft)**
0	**7.1**				0.0	**0.0**
0.100	4.4	195.3	12.5	-207.8	0.25	0.8
0.200	3.1	96.7	20.8	-117.5	0.42	1.4
0.300	2.3	53.1	26.9	-79.9	0.54	1.8
0.370	1.9	35.5	30.2	-65.6	0.61	2.0
0.400	1.7	29.8	31.4	-61.2	0.64	2.1
0.500	1.3	16.1	34.7	-50.8	0.70	2.3
0.570	1.0	9.8	36.5	-46.3	0.74	2.4
0.600	0.9	7.7	37.1	-44.8	0.75	2.5
0.700	0.5	2.7	38.7	-41.4	0.78	2.6
0.730	0.4	1.8	39.0	-40.8	0.79	2.6
0.800	0.2	0.4	39.5	-39.8	0.80	2.6
0.850		0.0	39.6	-39.6	0.80	2.6

Drops Diagonally into the Pool

Height of COM	h = 0.97	m	
Mass of Person	m = 26.30	kg =	58 lb
Density of Water	p_w = 1000.00	kg/m^3	
Density of Person	p_B = 980.00	kg/m^3	
Cross-Sectional Area	A = 0.09	m^2 =	1 ft^2
Length of Person	L = 0.92	m =	3.00520382 ft
Volume of Person	V = 0.33	m^3	
Coefficient of Drag	C_D = 1.00		
Gravitational Constant	g = 9.81	m/s^2	

Drag Force Equation $$F_D = \frac{1}{2} C_D A p_w v^2$$

Bouyancy Equation $$F_B = Vg(p_w - p_B)$$

Initial Conditions		
t_o =	0	s
v_o =	3.157	mph

ELAPSED TIME (s)	**VELOCITY AT TIME (mph)**	DRAG FORCE (N)	BOUYANCY FORCE (N)	NET FORCE (N)	DISTANCE (m)	**TOTAL DEPTH (ft)**
0	**7.1**				0.0	**0.0**
0.100	4.4	193.8	17.7	-211.5	0.25	0.8
0.200	3.1	93.4	29.3	-122.7	0.42	1.4
0.300	2.2	48.6	37.6	-86.2	0.54	1.8
0.370	1.8	30.5	42.0	-72.5	0.60	2.0
0.400	1.6	24.7	43.6	-68.3	0.62	2.0
0.500	1.0	11.1	47.7	-58.8	0.68	2.2
0.570	0.7	5.2	49.7	-54.9	0.71	2.3
0.600	0.6	3.5	50.3	-53.8	0.72	2.4
0.700	0.1	0.3	51.4	-51.7	0.74	2.4
0.730		0.0	51.5	-51.5	0.74	2.4
0.800						
0.850						

Drops with Tucked Knees into the Pool

Height of COM	h = 0.83	m	
Mass of Person	m = 26.30	kg =	58 lb
Density of Water	p_w = 1000.00	kg/m^3	
Density of Person	p_B = 980.00	kg/m^3	
Cross-Sectional Area	A = 0.20	m^2 =	2.125 ft^2
Length of Person	L = 0.65	m =	2.125 ft
Volume of Person	V = 0.33	m^3	
Coefficient of Drag	C_D = 1.00		
Gravitational Constant	g = 9.81	m/s^2	

Drag Force Equation $$F_D = \frac{1}{2} C_D A p_w v^2$$

Bouyancy Equation $$F_B = Vg(p_w - p_B)$$

Initial Conditions		
t_o =	0	s
v_o =	3.157	mph

ELAPSED TIME (s)	**VELOCITY AT TIME (mph)**	DRAG FORCE (N)	BOUYANCY FORCE (N)	NET FORCE (N)	DISTANCE (m)	**TOTAL DEPTH (ft)**
0	**7.1**				0.0	**0.0**
0.100	3.0	202.3	20.7	-223.0	0.21	0.7
0.200	1.8	70.4	31.2	-101.6	0.32	1.0
0.300	1.1	27.8	37.8	-65.6	0.38	1.3
0.370	0.8	13.6	40.8	-54.3	0.41	1.4
0.400	0.6	9.5	41.7	-51.2	0.42	1.4
0.500	0.2	1.6	43.8	-45.4	0.44	1.5
0.570		0.0	44.2	-44.2	0.45	1.5
0.600						
0.700						
0.730						
0.800						
0.850						

Drops Horizontally into the Pool

Height of COM	h = 0.66	m	
Mass of Person	m = 26.30	kg =	58 lb
Density of Water	p_w = 1000.00	kg/m^3	
Density of Person	p_B = 980.00	kg/m^3	
Cross-Sectional Area	A = 0.39	m^2 =	4.25 ft^2
Length of Person	L = 0.30	m =	1 ft
Volume of Person	V = 0.33	m^3	
Coefficient of Drag	C_D = 1.00		
Gravitational Constant	g = 9.81	m/s^2	

Drag Force Equation $F_D = \frac{1}{2} C_D A p_w v^2$

Bouyancy Equation $F_B = V g (p_w - p_B)$

Initial Conditions		
t_o =	0	s
v_o =	3.157	mph

ELAPSED TIME (s)	**VELOCITY AT TIME (mph)**	DRAG FORCE (N)	BOUYANCY FORCE (N)	NET FORCE (N)	DISTANCE (m)	**TOTAL DEPTH (ft)**
0	**7.1**				0.0	**0.0**
0.100	1.8	149.5	33.5	-182.9	0.16	0.5
0.200	0.8	32.9	45.7	-78.6	0.22	0.7
0.300	0.3	4.9	51.2	-56.1	0.24	0.8
0.370		0.0	52.3	-52.3	0.25	0.8
0.400						
0.500						
0.570						
0.600						
0.700						
0.730						
0.800						
0.850						

Drops Vertically into the Pool

Height of COM	h = 1.20	m	
Mass of Person	m = 32.65	kg =	72 lb
Density of Water	p_w = 1000.00	kg/m^3	
Density of Person	p_B = 980.00	kg/m^3	
Cross-Sectional Area	A = 0.09	m^2 =	1 ft^2
Length of Person	L = 1.38	m =	4.54166667 ft
Volume of Person	V = 0.33	m^3	
Coefficient of Drag	C_D = 1.00		
Gravitational Constant	g = 9.81	m/s^2	

Drag Force Equation $$F_D = \frac{1}{2} C_D A p_w v^2$$

Bouyancy Equation $$F_B = Vg(p_w - p_B)$$

Initial Conditions		
t_o =	0	s
v_o =	3.157	mph

ELAPSED TIME (s)	**VELOCITY AT TIME (mph)**	DRAG FORCE (N)	BOUYANCY FORCE (N)	NET FORCE (N)	DISTANCE (m)	**TOTAL DEPTH (ft)**
0	**7.1**				0.0	**0.0**
0.100	4.8	226.4	12.2	-238.6	0.26	0.9
0.200	3.5	123.2	20.8	-143.9	0.45	1.5
0.300	2.7	73.1	27.3	-100.4	0.59	1.9
0.400	2.1	44.9	32.4	-77.2	0.70	2.3
0.500	1.7	27.3	36.3	-63.6	0.79	2.6
0.600	1.3	15.9	39.4	-55.3	0.85	2.8
0.660	1.1	11.0	40.8	-51.8	0.89	2.9
0.700	0.9	8.3	41.7	-50.0	0.90	3.0
0.800	0.6	3.5	43.2	-46.8	0.94	3.1
0.850	0.4	1.9	43.8	-45.7	0.95	3.1
0.900	0.3	0.8	44.2	-45.0	0.96	3.1
0.990		0.0	44.4	-44.4	0.96	3.2

Drops Diagonally into the Pool

Height of COM	h = 1.00	m	
Mass of Person	m = 32.65	kg =	72 lb
Density of Water	p_w = 1000.00	kg/m^3	
Density of Person	p_B = 980.00	kg/m^3	
Cross-Sectional Area	A = 0.09	m^2 =	1 ft^2
Length of Person	L = 0.98	m =	3.2114433 ft
Volume of Person	V = 0.33	m^3	
Coefficient of Drag	C_D = 1.00		
Gravitational Constant	g = 9.81	m/s^2	

Drag Force Equation $$F_D = \frac{1}{2} C_D A p_w v^2$$

Bouyancy Equation $$F_B = Vg(p_w - p_B)$$

Initial Conditions		
t_o =	0	s
v_o =	3.157	mph

ELAPSED TIME (s)	**VELOCITY AT TIME (mph)**	DRAG FORCE (N)	BOUYANCY FORCE (N)	NET FORCE (N)	DISTANCE (m)	**TOTAL DEPTH (ft)**
0	**7.1**				0.0	**0.0**
0.100	4.8	225.2	17.2	-242.4	0.26	0.9
0.200	3.5	120.1	29.3	-149.4	0.45	1.5
0.300	2.6	68.7	38.3	-107.0	0.59	1.9
0.400	2.0	39.5	45.1	-84.7	0.69	2.3
0.500	1.5	21.6	50.3	-71.9	0.77	2.5
0.600	1.0	10.4	54.0	-64.4	0.83	2.7
0.660	0.8	5.9	55.6	-61.5	0.85	2.8
0.700	0.6	3.7	56.4	-60.1	0.86	2.8
0.800	0.2	0.5	57.6	-58.0	0.88	2.9
0.850		0.0	57.7	-57.7	0.88	2.9
0.900						
0.990						

Drops with Tucked Knees into the Pool

Height of COM	h = 0.85	m	
Mass of Person	m = 32.65	kg =	72 lb
Density of Water	p_w = 1000.00	kg/m^3	
Density of Person	p_B = 980.00	kg/m^3	
Cross-Sectional Area	A = 0.21	m^2 =	2.270833 ft^2
Length of Person	L = 0.69	m =	2.27083333 ft
Volume of Person	V = 0.33	m^3	
Coefficient of Drag	C_D = 1.00		
Gravitational Constant	g = 9.81	m/s^2	

Drag Force Equation $$F_D = \frac{1}{2} C_D A p_w v^2$$

Bouyancy Equation $$F_B = Vg(p_w - p_B)$$

Initial Conditions		
t_o =	0	s
v_o =	3.157	mph

ELAPSED TIME (s)	**VELOCITY AT TIME (mph)**	DRAG FORCE (N)	BOUYANCY FORCE (N)	NET FORCE (N)	DISTANCE (m)	**TOTAL DEPTH (ft)**
0	**7.1**				0.0	**0.0**
0.100	3.3	257.6	20.3	-277.8	0.22	0.7
0.200	2.1	98.2	31.3	-129.5	0.34	1.1
0.300	1.4	43.8	38.5	-82.3	0.42	1.4
0.400	0.9	19.0	43.3	-62.2	0.47	1.5
0.500	0.5	6.5	46.3	-52.8	0.50	1.6
0.600	0.2	0.9	47.8	-48.7	0.52	1.7
0.660		0.0	48.0	-48.0	0.52	1.7
0.700						
0.800						
0.850						
0.900						
0.990						

Drops Horizontally into the Pool

Height of COM	h = 0.66	m	
Mass of Person	m = 32.65	kg =	72 lb
Density of Water	p_w = 1000.00	kg/m^3	
Density of Person	p_B = 980.00	kg/m^3	
Cross-Sectional Area	A = 0.42	m^2 =	4.541667 ft^2
Length of Person	L = 0.30	m =	1 ft
Volume of Person	V = 0.33	m^3	
Coefficient of Drag	C_D = 1.00		
Gravitational Constant	g = 9.81	m/s^2	

Drag Force Equation $F_D = \frac{1}{2} C_D A p_w v^2$

Bouyancy Equation $F_B = Vg(p_w - p_B)$

Initial Conditions		
t_o =	0	s
v_o =	3.157	mph

ELAPSED TIME (s)	**VELOCITY AT TIME (mph)**	DRAG FORCE (N)	BOUYANCY FORCE (N)	NET FORCE (N)	DISTANCE (m)	**TOTAL DEPTH (ft)**
0	**7.1**				0.0	**0.0**
0.100	2.0	204.9	35.8	-240.7	0.17	0.6
0.200	1.0	52.0	50.1	-102.1	0.24	0.8
0.300	0.5	12.0	57.4	-69.4	0.27	0.9
0.400	0.1	0.4	60.0	-60.4	0.29	0.9
0.500						
0.600						
0.660						
0.700						
0.800						
0.850						
0.900						
0.990						

Drops Vertically into the Pool

Height of COM	h = 1.24	m	
Mass of Person	m = 43.54	kg =	96 lb
Density of Water	p_w = 1000.00	kg/m^3	
Density of Person	p_B = 980.00	kg/m^3	
Cross-Sectional Area	A = 0.09	m^2 =	1 ft^2
Length of Person	L = 1.47	m =	4.8125 ft
Volume of Person	V = 0.33	m^3	
Coefficient of Drag	C_D = 1.00		
Gravitational Constant	g = 9.81	m/s^2	

Drag Force Equation $$F_D = \frac{1}{2} C_D A p_w v^2$$

Bouyancy Equation $$F_B = Vg(p_w - p_B)$$

Initial Conditions		
t_o =	0	s
v_o =	3.157	mph

ELAPSED TIME (s)	**VELOCITY AT TIME (mph)**	DRAG FORCE (N)	BOUYANCY FORCE (N)	NET FORCE (N)	DISTANCE (m)	**TOTAL DEPTH (ft)**
0	**7.1**				0.0	**0.0**
0.100	5.2	266.3	12.0	-278.2	0.27	0.9
0.200	4.1	161.8	21.0	-182.9	0.48	1.6
0.300	3.3	105.0	28.3	-133.2	0.65	2.1
0.400	2.7	70.3	34.1	-104.4	0.78	2.6
0.490	2.3	49.3	38.5	-87.8	0.88	2.9
0.500	2.2	47.4	38.9	-86.3	0.89	2.9
0.600	1.8	31.6	42.9	-74.5	0.98	3.2
0.700	1.4	20.4	46.1	-66.5	1.06	3.5
0.790	1.2	13.1	48.4	-61.5	1.11	3.6
0.800	1.1	12.4	48.6	-61.0	1.12	3.7
0.900	0.8	6.7	50.5	-57.3	1.16	3.8
1.000	0.5	2.9	51.9	-54.8	1.19	3.9
1.100	0.3	0.7	52.7	-53.4	1.21	4.0
1.200		0.0	52.9	-52.9	1.22	4.0

Drops Diagonally into the Pool

Height of COM	h = 1.03	m	
Mass of Person	m = 43.54	kg =	96 lb
Density of Water	p_w = 1000.00	kg/m^3	
Density of Person	p_B = 980.00	kg/m^3	
Cross-Sectional Area	A = 0.09	m^2 =	1 ft^2
Length of Person	L = 1.04	m =	3.40295138 ft
Volume of Person	V = 0.33	m^3	
Coefficient of Drag	C_D = 1.00		
Gravitational Constant	g = 9.81	m/s^2	

Drag Force Equation $$F_D = \frac{1}{2} C_D A p_w v^2$$

Bouyancy Equation $$F_B = Vg(p_W - p_B)$$

Initial Conditions		
t_o =	0	s
v_o =	3.157	mph

ELAPSED TIME (s)	**VELOCITY AT TIME (mph)**	DRAG FORCE (N)	BOUYANCY FORCE (N)	NET FORCE (N)	DISTANCE (m)	**TOTAL DEPTH (ft)**
0	**7.1**				0.0	**0.0**
0.100	5.2	265.2	16.9	-282.1	0.27	0.9
0.200	4.0	159.1	29.7	-188.8	0.48	1.6
0.300	3.2	100.7	39.7	-140.5	0.65	2.1
0.400	2.6	64.8	47.8	-112.6	0.78	2.5
0.490	2.1	43.2	53.7	-96.8	0.87	2.9
0.500	2.1	41.2	54.2	-95.4	0.88	2.9
0.600	1.6	25.1	59.3	-84.4	0.96	3.2
0.700	1.2	14.0	63.2	-77.2	1.03	3.4
0.790	0.8	7.2	65.8	-73.0	1.07	3.5
0.800	0.8	6.6	66.0	-72.6	1.07	3.5
0.900	0.4	2.1	67.8	-69.9	1.10	3.6
1.000	0.1	0.1	68.5	-68.7	1.11	3.7
1.100						
1.200						

Drops with Tucked Knees into the Pool

Height of COM	h = 0.87	m	
Mass of Person	m = 43.54	kg =	96 lb
Density of Water	p_w = 1000.00	kg/m^3	
Density of Person	p_B = 980.00	kg/m^3	
Cross-Sectional Area	A = 0.22	m^2 =	2.40625 ft^2
Length of Person	L = 0.73	m =	2.40625 ft
Volume of Person	V = 0.33	m^3	
Coefficient of Drag	C_D = 1.00		
Gravitational Constant	g = 9.81	m/s^2	

Drag Force Equation $$F_D = \frac{1}{2} C_D A p_w v^2$$

Bouyancy Equation $$F_B = Vg(p_w - p_B)$$

Initial Conditions		
t_o =	0	s
v_o =	3.157	mph

ELAPSED TIME (s)	**VELOCITY AT TIME (mph)**	DRAG FORCE (N)	BOUYANCY FORCE (N)	NET FORCE (N)	DISTANCE (m)	**TOTAL DEPTH (ft)**
0	**7.1**				0.0	**0.0**
0.100	3.7	345.5	20.4	-365.9	0.23	0.8
0.200	2.5	148.0	32.5	-180.5	0.37	1.2
0.300	1.8	74.2	40.8	-115.0	0.47	1.5
0.400	1.3	38.3	46.7	-85.0	0.54	1.8
0.490	0.9	20.1	50.6	-70.7	0.58	1.9
0.500	0.9	18.6	50.9	-69.6	0.58	1.9
0.600	0.5	7.4	53.8	-61.2	0.62	2.0
0.700	0.2	1.7	55.4	-57.0	0.64	2.1
0.790		0.0	55.8	-55.8	0.64	2.1
0.800						
0.900						
1.000						
1.100						
1.200						

Drops Horizontally into the Pool

Height of COM	$h = 0.66$	m	
Mass of Person	$m = 43.54$	kg =	96 lb
Density of Water	$p_w = 1000.00$	kg/m^3	
Density of Person	$p_B = 980.00$	kg/m^3	
Cross-Sectional Area	$A = 0.45$	m^2 =	4.8125 ft^2
Length of Person	$L = 0.30$	m =	1 ft
Volume of Person	$V = 0.33$	m^3	
Coefficient of Drag	$C_D = 1.00$		
Gravitational Constant	$g = 9.81$	m/s^2	

Drag Force Equation $$F_D = \frac{1}{2} C_D A p_w v^2$$

Bouyancy Equation $$F_B = Vg(p_w - p_B)$$

Initial Conditions		
t_o =	0	s
v_o =	3.157	mph

ELAPSED TIME (s)	**VELOCITY AT TIME (mph)**	DRAG FORCE (N)	BOUYANCY FORCE (N)	NET FORCE (N)	DISTANCE (m)	**TOTAL DEPTH (ft)**
0	**7.1**				0.0	**0.0**
0.100	2.4	306.2	39.4	-345.6	0.19	0.6
0.200	1.4	91.0	57.0	-148.0	0.27	0.9
0.300	0.8	29.3	67.0	-96.3	0.32	1.0
0.400	0.3	6.0	72.2	-78.2	0.34	1.1
0.490		0.0	73.6	-73.6	0.35	1.2
0.500						
0.600						
0.700						
0.790						
0.800						
0.900						
1.000						
1.100						
1.200						

12-year-old Girl Calculations

Drops Vertically into the Pool

Height of COM	h = 1.22	m	
Mass of Person	m = 32.65	kg =	72 lb
Density of Water	p_w = 1000.00	kg/m^3	
Density of Person	p_B = 980.00	kg/m^3	
Cross-Sectional Area	A = 0.09	m^2 =	1 ft^2
Length of Person	L = 1.42	m =	4.64583333 ft
Volume of Person	V = 0.33	m^3	
Coefficient of Drag	C_D = 1.00		
Gravitational Constant	g = 9.81	m/s^2	

Drag Force Equation $$F_D = \frac{1}{2} C_D A p_w v^2$$

Bouyancy Equation $$F_B = Vg(p_w - p_B)$$

Initial Conditions		
t_o =	0	s
v_o =	3.157	mph

ELAPSED TIME (s)	**VELOCITY AT TIME (mph)**	DRAG FORCE (N)	BOUYANCY FORCE (N)	NET FORCE (N)	DISTANCE (m)	**TOTAL DEPTH (ft)**
0	**7.1**				0.0	**0.0**
0.100	4.8	226.5	11.9	-238.4	0.26	0.9
0.200	3.5	123.3	20.3	-143.6	0.45	1.5
0.300	2.7	73.4	26.7	-100.1	0.59	1.9
0.400	2.2	45.2	31.7	-76.8	0.70	2.3
0.500	1.7	27.6	35.6	-63.2	0.79	2.6
0.600	1.3	16.2	38.6	-54.8	0.85	2.8
0.660	1.1	11.3	40.0	-51.3	0.89	2.9
0.700	0.9	8.6	40.8	-49.4	0.91	3.0
0.800	0.6	3.7	42.4	-46.2	0.94	3.1
0.860	0.4	1.9	43.0	-44.9	0.95	3.1
0.900	0.3	1.0	43.3	-44.3	0.96	3.2
1.000		0.0	43.7	-43.7	0.97	3.2

Drops Diagonally into the Pool

Height of COM	$h = 1.01$	m	
Mass of Person	$m = 32.65$	kg =	72 lb
Density of Water	$p_w = 1000.00$	kg/m^3	
Density of Person	$p_B = 980.00$	kg/m^3	
Cross-Sectional Area	$A = 0.09$	m^2 =	1 ft^2
Length of Person	$L = 1.00$	m =	3.28510025 ft
Volume of Person	$V = 0.33$	m^3	
Coefficient of Drag	$C_D = 1.00$		
Gravitational Constant	$g = 9.81$	m/s^2	

Drag Force Equation $$F_D = \frac{1}{2} C_D A p_w v^2$$

Bouyancy Equation $$F_B = V g (p_w - p_B)$$

Initial Conditions		
$t_o =$	0	s
$v_o =$	3.157	mph

ELAPSED TIME (s)	**VELOCITY AT TIME (mph)**	DRAG FORCE (N)	BOUYANCY FORCE (N)	NET FORCE (N)	DISTANCE (m)	**TOTAL DEPTH (ft)**
0	**7.1**				0.0	**0.0**
0.100	4.8	225.3	16.8	-242.1	0.26	0.9
0.200	3.5	120.3	28.6	-149.0	0.45	1.5
0.300	2.7	69.1	37.4	-106.5	0.59	1.9
0.400	2.0	39.9	44.2	-84.1	0.69	2.3
0.500	1.5	22.1	49.2	-71.3	0.77	2.5
0.600	1.0	10.8	52.9	-63.7	0.83	2.7
0.660	0.8	6.3	54.5	-60.7	0.85	2.8
0.700	0.6	4.0	55.3	-59.3	0.87	2.8
0.800	0.2	0.6	56.5	-57.2	0.89	2.9
0.860		0.0	56.7	-56.8	0.89	2.9
0.900						
1.000						

Drops with Tucked Knees into the Pool

Height of COM	h = 0.86	m	
Mass of Person	m = 32.65	kg =	72 lb
Density of Water	p_w = 1000.00	kg/m^3	
Density of Person	p_B = 980.00	kg/m^3	
Cross-Sectional Area	A = 0.22	m^2 =	2.322917 ft^2
Length of Person	L = 0.71	m =	2.32291667 ft
Volume of Person	V = 0.33	m^3	
Coefficient of Drag	C_D = 1.00		
Gravitational Constant	g = 9.81	m/s^2	

Drag Force Equation $$F_D = \frac{1}{2} C_D A p_w v^2$$

Bouyancy Equation $$F_B = Vg(p_w - p_B)$$

Initial Conditions		
t_o =	0	s
v_o =	3.157	mph

ELAPSED TIME (s)	**VELOCITY AT TIME (mph)**	DRAG FORCE (N)	BOUYANCY FORCE (N)	NET FORCE (N)	DISTANCE (m)	**TOTAL DEPTH (ft)**
0	**7.1**				0.0	**0.0**
0.100	3.3	257.3	19.7	-277.1	0.22	0.7
0.200	2.0	97.6	30.3	-127.9	0.34	1.1
0.300	1.4	43.5	37.2	-80.8	0.41	1.4
0.400	0.9	19.0	41.9	-60.8	0.46	1.5
0.500	0.5	6.6	44.8	-51.4	0.50	1.6
0.600	0.2	1.0	46.3	-47.3	0.51	1.7
0.660		0.0	46.5	-46.5	0.52	1.7
0.700						
0.800						
0.860						
0.900						
1.000						

Drops Horizontally into the Pool

Height of COM	h = 0.66	m	
Mass of Person	m = 32.65	kg =	72 lb
Density of Water	p_w = 1000.00	kg/m^3	
Density of Person	p_B = 980.00	kg/m^3	
Cross-Sectional Area	A = 0.43	m^2 =	4.645833 ft^2
Length of Person	L = 0.30	m =	1 ft
Volume of Person	V = 0.33	m^3	
Coefficient of Drag	C_D = 1.00		
Gravitational Constant	g = 9.81	m/s^2	

Drag Force Equation $$F_D = \frac{1}{2} C_D A p_w v^2$$

Bouyancy Equation $$F_B = Vg(p_w - p_B)$$

Initial Conditions		
t_o =	0	s
v_o =	3.157	mph

ELAPSED TIME (s)	**VELOCITY AT TIME (mph)**	DRAG FORCE (N)	BOUYANCY FORCE (N)	NET FORCE (N)	DISTANCE (m)	**TOTAL DEPTH (ft)**
0	**7.1**				0.0	**0.0**
0.100	2.0	202.6	35.5	-238.1	0.17	0.6
0.200	1.0	51.0	49.5	-100.5	0.24	0.8
0.300	0.5	11.7	56.6	-68.3	0.27	0.9
0.400	0.0	0.3	59.2	-59.5	0.28	0.9
0.500						
0.600						
0.660						
0.700						
0.800						
0.860						
0.900						
1.000						

Drops Vertically into the Pool

Height of COM	$h = 1.26$	m	
Mass of Person	$m = 41.72$	kg =	92 lb
Density of Water	$p_w = 1000.00$	kg/m^3	
Density of Person	$p_B = 980.00$	kg/m^3	
Cross-Sectional Area	$A = 0.09$	m^2 =	1 ft^2
Length of Person	$L = 1.51$	m =	4.95833333 ft
Volume of Person	$V = 0.33$	m^3	
Coefficient of Drag	$C_D = 1.00$		
Gravitational Constant	$g = 9.81$	m/s^2	

Drag Force Equation $$F_D = \frac{1}{2} C_D A p_w v^2$$

Bouyancy Equation $$F_B = Vg(p_w - p_B)$$

Initial Conditions		
t_o =	0	s
v_o =	3.157	mph

ELAPSED TIME (s)	**VELOCITY AT TIME (mph)**	DRAG FORCE (N)	BOUYANCY FORCE (N)	NET FORCE (N)	DISTANCE (m)	**TOTAL DEPTH (ft)**
0	**7.1**				0.0	**0.0**
0.100	5.2	260.6	11.5	-272.2	0.27	0.9
0.200	4.0	156.2	20.2	-176.4	0.48	1.6
0.300	3.2	100.3	27.1	-127.4	0.64	2.1
0.400	2.6	66.6	32.7	-99.2	0.77	2.5
0.480	2.2	48.3	36.4	-84.7	0.86	2.8
0.500	2.1	44.6	37.2	-81.8	0.88	2.9
0.600	1.7	29.5	40.9	-70.4	0.97	3.2
0.700	1.4	18.9	43.9	-62.7	1.04	3.4
0.780	1.1	12.6	45.8	-58.4	1.08	3.6
0.800	1.1	11.3	46.2	-57.5	1.09	3.6
0.900	0.8	6.0	48.0	-54.0	1.14	3.7
1.000	0.5	2.5	49.2	-51.7	1.16	3.8
1.100	0.2	0.6	49.9	-50.5	1.18	3.9
1.190		0.0	50.1	-50.1	1.19	3.9

Drops Diagonally into the Pool

Height of COM	h = 1.04	m	
Mass of Person	m = 41.72	kg =	92 lb
Density of Water	p_w = 1000.00	kg/m^3	
Density of Person	p_B = 980.00	kg/m^3	
Cross-Sectional Area	A = 0.09	m^2 =	1 ft^2
Length of Person	L = 1.07	m =	3.50607112 ft
Volume of Person	V = 0.33	m^3	
Coefficient of Drag	C_D = 1.00		
Gravitational Constant	g = 9.81	m/s^2	

Drag Force Equation $$F_D = \frac{1}{2} C_D A p_w v^2$$

Bouyancy Equation $$F_B = Vg(p_w - p_B)$$

Initial Conditions		
t_o =	0	s
v_o =	3.157	mph

ELAPSED TIME (s)	**VELOCITY AT TIME (mph)**	DRAG FORCE (N)	BOUYANCY FORCE (N)	NET FORCE (N)	DISTANCE (m)	**TOTAL DEPTH (ft)**
0	**7.1**				0.0	**0.0**
0.100	5.1	259.6	16.3	-275.9	0.27	0.9
0.200	4.0	153.5	28.5	-182.0	0.48	1.6
0.300	3.1	96.1	38.1	-134.3	0.64	2.1
0.400	2.5	61.3	45.7	-107.1	0.76	2.5
0.480	2.1	42.5	50.7	-93.2	0.85	2.8
0.500	2.0	38.6	51.8	-90.4	0.87	2.8
0.600	1.5	23.3	56.6	-79.8	0.95	3.1
0.700	1.1	12.8	60.2	-72.9	1.01	3.3
0.780	0.8	7.0	62.3	-69.3	1.04	3.4
0.800	0.8	5.8	62.7	-68.6	1.05	3.4
0.900	0.4	1.7	64.3	-66.1	1.08	3.5
1.000	0.0	0.1	65.0	-65.0	1.09	3.6
1.100						
1.190						

Drops with Tucked Knees into the Pool

Height of COM	h = 0.89	m	
Mass of Person	m = 41.72	kg =	92 lb
Density of Water	p_w = 1000.00	kg/m^3	
Density of Person	p_B = 980.00	kg/m^3	
Cross-Sectional Area	A = 0.23	m^2 =	2.479167 ft^2
Length of Person	L = 0.76	m =	2.47916667 ft
Volume of Person	V = 0.33	m^3	
Coefficient of Drag	C_D = 1.00		
Gravitational Constant	g = 9.81	m/s^2	

Drag Force Equation $$F_D = \frac{1}{2} C_D A p_w v^2$$

Bouyancy Equation $$F_B = Vg(p_w - p_B)$$

Initial Conditions		
t_o =	0	s
v_o =	3.157	mph

ELAPSED TIME (s)	**VELOCITY AT TIME (mph)**	DRAG FORCE (N)	BOUYANCY FORCE (N)	NET FORCE (N)	DISTANCE (m)	**TOTAL DEPTH (ft)**
0	**7.1**				0.0	**0.0**
0.100	3.6	332.4	19.4	-351.8	0.23	0.8
0.200	2.4	138.5	30.7	-169.2	0.36	1.2
0.300	1.7	68.2	38.3	-106.5	0.45	1.5
0.400	1.2	34.7	43.7	-78.4	0.52	1.7
0.480	0.9	19.3	46.9	-66.2	0.55	1.8
0.500	0.8	16.5	47.6	-64.0	0.56	1.8
0.600	0.5	6.3	50.1	-56.4	0.59	1.9
0.700	0.2	1.2	51.4	-52.7	0.61	2.0
0.780		0.0	51.8	-51.8	0.61	2.0
0.800						
0.900						
1.000						
1.100						
1.190						

Drops Horizontally into the Pool

Height of COM	h = 0.66	m	
Mass of Person	m = 41.72	kg =	92 lb
Density of Water	p_w = 1000.00	kg/m^3	
Density of Person	p_B = 980.00	kg/m^3	
Cross-Sectional Area	A = 0.46	m^2 =	4.958333 ft^2
Length of Person	L = 0.30	m =	1 ft
Volume of Person	V = 0.33	m^3	
Coefficient of Drag	C_D = 1.00		
Gravitational Constant	g = 9.81	m/s^2	

Drag Force Equation $$F_D = \frac{1}{2} C_D A p_w v^2$$

Bouyancy Equation $$F_B = Vg(p_w - p_B)$$

Initial Conditions		
t_o =	0	s
v_o =	3.157	mph

ELAPSED TIME (s)	**VELOCITY AT TIME (mph)**	DRAG FORCE (N)	BOUYANCY FORCE (N)	NET FORCE (N)	DISTANCE (m)	**TOTAL DEPTH (ft)**
0	**7.1**				0.0	**0.0**
0.100	2.3	285.1	38.3	-323.4	0.18	0.6
0.200	1.3	81.9	54.9	-136.8	0.26	0.9
0.300	0.7	25.1	64.1	-89.2	0.31	1.0
0.400	0.3	4.3	68.7	-73.1	0.33	1.1
0.480		0.0	69.7	-69.7	0.33	1.1
0.500						
0.600						
0.700						
0.780						
0.800						
0.900						
1.000						
1.100						
1.190						

Drops Vertically into the Pool

Height of COM	h = 1.31	m	
Mass of Person	m = 55.33	kg =	122 lb
Density of Water	p_w = 1000.00	kg/m^3	
Density of Person	p_B = 980.00	kg/m^3	
Cross-Sectional Area	A = 0.09	m^2 =	1 ft^2
Length of Person	L = 1.61	m =	5.27083333 ft
Volume of Person	V = 0.33	m^3	
Coefficient of Drag	C_D = 1.00		
Gravitational Constant	g = 9.81	m/s^2	

Drag Force Equation $$F_D = \frac{1}{2} C_D A p_w v^2$$

Bouyancy Equation $$F_B = Vg(p_w - p_B)$$

Initial Conditions		
t_o =	0	s
v_o =	3.157	mph

ELAPSED TIME (s)	**VELOCITY AT TIME (mph)**	DRAG FORCE (N)	BOUYANCY FORCE (N)	NET FORCE (N)	DISTANCE (m)	**TOTAL DEPTH (ft)**
0	**7.1**				0.0	**0.0**
0.100	5.5	297.0	11.2	-308.2	0.28	0.9
0.200	4.5	196.1	20.2	-216.3	0.51	1.7
0.300	3.8	135.9	27.6	-163.5	0.69	2.3
0.400	3.2	96.8	33.8	-130.6	0.85	2.8
0.500	2.7	69.9	39.0	-108.9	0.98	3.2
0.550	2.5	59.5	41.4	-100.8	1.04	3.4
0.600	2.3	50.5	43.5	-94.0	1.09	3.6
0.700	1.9	36.1	47.3	-83.4	1.19	3.9
0.800	1.6	25.3	50.5	-75.8	1.27	4.2
0.900	1.3	17.0	53.1	-70.2	1.34	4.4
0.930	1.2	15.0	53.8	-68.8	1.35	4.4
1.000	1.1	10.8	55.3	-66.1	1.39	4.6
1.100	0.8	6.2	56.9	-63.1	1.43	4.7
1.200	0.5	3.0	58.1	-61.1	1.46	4.8
1.230	0.5	2.3	58.4	-60.6	1.47	4.8
1.300	0.3	1.0	58.9	-59.9	1.48	4.9
1.400	0.1	0.1	59.2	-59.3	1.49	4.9
1.430		0.0	59.2	-59.2	1.49	4.9

Drops Diagonally into the Pool

Height of COM	h = 1.08	m	
Mass of Person	m = 55.33	kg =	122 lb
Density of Water	p_w = 1000.00	kg/m^3	
Density of Person	p_B = 980.00	kg/m^3	
Cross-Sectional Area	A = 0.09	m^2 =	1 ft^2
Length of Person	L = 1.14	m =	3.72704199 ft
Volume of Person	V = 0.33	m^3	
Coefficient of Drag	C_D = 1.00		
Gravitational Constant	g = 9.81	m/s^2	

Drag Force Equation $$F_D = \frac{1}{2} C_D A p_w v^2$$

Bouyancy Equation $$F_B = V g (p_w - p_B)$$

Initial Conditions		
t_o =	0	s
v_o =	3.157	mph

ELAPSED TIME (s)	**VELOCITY AT TIME (mph)**	DRAG FORCE (N)	BOUYANCY FORCE (N)	NET FORCE (N)	DISTANCE (m)	**TOTAL DEPTH (ft)**
0	**7.1**				0.0	**0.0**
0.100	5.5	296.1	15.9	-312.0	0.28	0.9
0.200	4.5	193.7	28.5	-222.2	0.51	1.7
0.300	3.7	132.1	38.8	-170.9	0.69	2.3
0.400	3.1	91.7	47.4	-139.2	0.84	2.8
0.500	2.6	63.8	54.6	-118.4	0.97	3.2
0.550	2.3	53.0	57.7	-110.7	1.03	3.4
0.600	2.1	43.7	60.5	-104.3	1.08	3.5
0.700	1.7	29.0	65.4	-94.4	1.16	3.8
0.800	1.4	18.2	69.4	-87.5	1.23	4.0
0.900	1.0	10.3	72.4	-82.7	1.29	4.2
0.930	0.9	8.5	73.2	-81.6	1.30	4.3
1.000	0.7	4.9	74.6	-79.5	1.33	4.4
1.100	0.4	1.6	76.0	-77.5	1.35	4.4
1.200	0.1	0.1	76.6	-76.7	1.36	4.5
1.230		0.0	76.6	-76.6	1.36	4.5
1.300						
1.400						
1.430						

Drops with Tucked Knees into the Pool

Height of COM	$h = 0.91$	m	
Mass of Person	$m = 55.33$	kg =	122 lb
Density of Water	$p_w = 1000.00$	kg/m^3	
Density of Person	$p_B = 980.00$	kg/m^3	
Cross-Sectional Area	$A = 0.24$	m^2 =	2.635417 ft^2
Length of Person	$L = 0.80$	m =	2.63541667 ft
Volume of Person	$V = 0.33$	m^3	
Coefficient of Drag	$C_D = 1.00$		
Gravitational Constant	$g = 9.81$	m/s^2	

Drag Force Equation $$F_D = \frac{1}{2} C_D A p_w v^2$$

Bouyancy Equation $$F_B = Vg(p_w - p_B)$$

Initial Conditions		
$t_o =$	0	s
$v_o =$	3.157	mph

ELAPSED TIME (s)	**VELOCITY AT TIME (mph)**	DRAG FORCE (N)	BOUYANCY FORCE (N)	NET FORCE (N)	DISTANCE (m)	**TOTAL DEPTH (ft)**
0	**7.1**				0.0	**0.0**
0.100	4.0	433.7	19.3	-453.0	0.24	0.8
0.200	2.8	200.5	31.3	-231.8	0.39	1.3
0.300	2.0	108.0	39.9	-147.9	0.50	1.6
0.400	1.5	61.4	46.3	-107.8	0.58	1.9
0.500	1.2	34.8	51.2	-86.0	0.64	2.1
0.550	1.0	25.7	53.1	-78.8	0.67	2.2
0.600	0.8	18.5	54.8	-73.3	0.69	2.3
0.700	0.6	8.5	57.3	-65.8	0.72	2.4
0.800	0.3	2.7	58.9	-61.6	0.74	2.4
0.900	0.1	0.2	59.6	-59.8	0.75	2.5
0.930		0.0	59.6	-59.6	0.75	2.5
1.000						
1.100						
1.200						
1.230						
1.300						
1.400						
1.430						

Drops Horizontally into the Pool

Height of COM	h = 0.66	m	
Mass of Person	m = 55.33	kg =	122 lb
Density of Water	p_w = 1000.00	kg/m^3	
Density of Person	p_B = 980.00	kg/m^3	
Cross-Sectional Area	A = 0.49	m^2 =	5.270833 ft^2
Length of Person	L = 0.30	m =	1 ft
Volume of Person	V = 0.33	m^3	
Coefficient of Drag	C_D = 1.00		
Gravitational Constant	g = 9.81	m/s^2	

Drag Force Equation $F_D = \frac{1}{2} C_D A p_w v^2$

Bouyancy Equation $F_B = Vg(p_w - p_B)$

Initial Conditions		
t_o =	0	s
v_o =	3.157	mph

ELAPSED TIME (s)	**VELOCITY AT TIME (mph)**	DRAG FORCE (N)	BOUYANCY FORCE (N)	NET FORCE (N)	DISTANCE (m)	**TOTAL DEPTH (ft)**
0	**7.1**				0.0	**0.0**
0.100	2.7	411.5	41.6	-453.1	0.20	0.7
0.200	1.6	134.8	61.6	-196.4	0.29	1.0
0.300	1.0	51.0	73.6	-124.6	0.35	1.2
0.400	0.5	16.2	80.8	-97.0	0.39	1.3
0.500	0.2	2.1	84.3	-86.4	0.40	1.3
0.550		0.1	84.8	-84.8	0.40	1.3
0.600						
0.700						
0.800						
0.900						
0.930						
1.000						
1.100						
1.200						
1.230						
1.300						
1.400						
1.430						

14-year-old Girl Calculations

Drops Vertically into the Pool

Height of COM	h = 1.27	m	
Mass of Person	m = 39.46	kg =	87 lb
Density of Water	p_w = 1000.00	kg/m^3	
Density of Person	p_B = 980.00	kg/m^3	
Cross-Sectional Area	A = 0.09	m^2 =	1 ft^2
Length of Person	L = 1.52	m =	4.97916667 ft
Volume of Person	V = 0.33	m^3	
Coefficient of Drag	C_D = 1.00		
Gravitational Constant	g = 9.81	m/s^2	

Drag Force Equation $$F_D = \frac{1}{2} C_D A p_w v^2$$

Bouyancy Equation $$F_B = Vg(p_w - p_B)$$

Initial Conditions		
t_o =	0	s
v_o =	3.157	mph

ELAPSED TIME (s)	**VELOCITY AT TIME (mph)**	DRAG FORCE (N)	BOUYANCY FORCE (N)	NET FORCE (N)	DISTANCE (m)	**TOTAL DEPTH (ft)**
0	**7.1**				0.0	**0.0**
0.100	5.1	253.1	11.4	-264.5	0.27	0.9
0.200	3.9	148.6	19.9	-168.5	0.47	1.6
0.300	3.1	94.0	26.5	-120.5	0.63	2.1
0.400	2.5	61.5	31.9	-93.4	0.76	2.5
0.460	2.2	48.0	34.6	-82.5	0.82	2.7
0.500	2.0	40.6	36.2	-76.8	0.86	2.8
0.600	1.6	26.4	39.7	-66.1	0.94	3.1
0.700	1.3	16.4	42.5	-58.9	1.01	3.3
0.750	1.1	12.6	43.7	-56.3	1.04	3.4
0.800	1.0	9.5	44.7	-54.1	1.06	3.5
0.900	0.7	4.7	46.2	-50.9	1.10	3.6
0.990	0.4	1.9	47.2	-49.1	1.12	3.7
1.000	0.4	1.7	47.3	-49.0	1.12	3.7
1.100	0.1	0.2	47.8	-48.0	1.14	3.7
1.150		0.0	47.9	-47.9	1.14	3.7

Drops Diagonally into the Pool

Height of COM	h = 1.04	m	
Mass of Person	m = 39.46	kg =	87 lb
Density of Water	p_w = 1000.00	kg/m^3	
Density of Person	p_B = 980.00	kg/m^3	
Cross-Sectional Area	A = 0.09	m^2 =	1 ft^2
Length of Person	L = 1.07	m =	3.52080251 ft
Volume of Person	V = 0.33	m^3	
Coefficient of Drag	C_D = 1.00		
Gravitational Constant	g = 9.81	m/s^2	

Drag Force Equation $$F_D = \frac{1}{2} C_D A p_w v^2$$

Bouyancy Equation $$F_B = Vg(p_w - p_B)$$

Initial Conditions		
t_o =	0	s
v_o =	3.157	mph

ELAPSED TIME (s)	**VELOCITY AT TIME (mph)**	DRAG FORCE (N)	BOUYANCY FORCE (N)	NET FORCE (N)	DISTANCE (m)	**TOTAL DEPTH (ft)**
0	**7.1**				0.0	**0.0**
0.100	5.1	252.0	16.1	-268.2	0.27	0.9
0.200	3.9	145.9	28.1	-173.9	0.47	1.5
0.300	3.0	89.9	37.3	-127.1	0.63	2.1
0.400	2.4	56.3	44.6	-100.9	0.75	2.5
0.460	2.1	42.3	48.2	-90.6	0.81	2.7
0.500	1.9	34.8	50.4	-85.1	0.85	2.8
0.600	1.4	20.3	54.8	-75.2	0.92	3.0
0.700	1.0	10.7	58.2	-68.8	0.98	3.2
0.750	0.8	7.2	59.4	-66.6	1.00	3.3
0.800	0.7	4.4	60.5	-64.9	1.02	3.3
0.900	0.3	1.0	61.8	-62.8	1.04	3.4
0.990		0.0	62.1	-62.1	1.04	3.4
1.000						
1.100						
1.150						

Drops with Tucked Knees into the Pool

Height of COM	h = 0.89	m	
Mass of Person	m = 39.46	kg =	87 lb
Density of Water	p_w = 1000.00	kg/m^3	
Density of Person	p_B = 980.00	kg/m^3	
Cross-Sectional Area	A = 0.23	m^2 =	2.489583 ft^2
Length of Person	L = 0.76	m =	2.48958333 ft
Volume of Person	V = 0.33	m^3	
Coefficient of Drag	C_D = 1.00		
Gravitational Constant	g = 9.81	m/s^2	

Drag Force Equation $$F_D = \frac{1}{2} C_D A p_w v^2$$

Bouyancy Equation $$F_B = V g (p_w - p_B)$$

Initial Conditions		
t_o =	0	s
v_o =	3.157	mph

ELAPSED TIME (s)	**VELOCITY AT TIME (mph)**	DRAG FORCE (N)	BOUYANCY FORCE (N)	NET FORCE (N)	DISTANCE (m)	**TOTAL DEPTH (ft)**
0	**7.1**				0.0	**0.0**
0.100	3.5	314.3	19.0	-333.4	0.23	0.7
0.200	2.3	127.6	29.8	-157.4	0.35	1.2
0.300	1.6	61.5	37.1	-98.6	0.44	1.4
0.400	1.1	30.5	42.2	-72.6	0.50	1.6
0.460	0.9	19.3	44.4	-63.8	0.53	1.7
0.500	0.7	13.8	45.7	-59.5	0.54	1.8
0.600	0.4	4.8	47.9	-52.7	0.57	1.9
0.700	0.1	0.6	49.0	-49.7	0.58	1.9
0.750		0.0	49.2	-49.2	0.58	1.9
0.800						
0.900						
0.990						
1.000						
1.100						
1.150						

Drops Horizontally into the Pool

Height of COM	$h = 0.66$	m	
Mass of Person	$m = 39.46$	kg =	87 lb
Density of Water	$p_w = 1000.00$	kg/m^3	
Density of Person	$p_B = 980.00$	kg/m^3	
Cross-Sectional Area	$A = 0.46$	m^2 =	4.979167 ft^2
Length of Person	$L = 0.30$	m =	1 ft
Volume of Person	$V = 0.33$	m^3	
Coefficient of Drag	$C_D = 1.00$		
Gravitational Constant	$g = 9.81$	m/s^2	

Drag Force Equation $$F_D = \frac{1}{2} C_D A p_w v^2$$

Bouyancy Equation $$F_B = Vg(p_w - p_B)$$

Initial Conditions		
t_o =	0	s
v_o =	3.157	mph

ELAPSED TIME (s)	**VELOCITY AT TIME (mph)**	DRAG FORCE (N)	BOUYANCY FORCE (N)	NET FORCE (N)	DISTANCE (m)	**TOTAL DEPTH (ft)**
0	**7.1**				0.0	**0.0**
0.100	2.2	262.2	37.4	-299.6	0.18	0.6
0.200	1.2	72.8	53.1	-125.9	0.25	0.8
0.300	0.6	21.0	61.7	-82.7	0.29	1.0
0.400	0.2	2.9	65.7	-68.6	0.31	1.0
0.460		0.0	66.4	-66.4	0.32	1.0
0.500						
0.600						
0.700						
0.750						
0.800						
0.900						
0.990						
1.000						
1.100						
1.150						

Drops Vertically into the Pool

Height of COM	h = 1.31	m	
Mass of Person	m = 48.98	kg =	108 lb
Density of Water	p_w = 1000.00	kg/m^3	
Density of Person	p_B = 980.00	kg/m^3	
Cross-Sectional Area	A = 0.09	m^2 =	1 ft^2
Length of Person	L = 1.61	m =	5.27083333 ft
Volume of Person	V = 0.33	m^3	
Coefficient of Drag	C_D = 1.00		
Gravitational Constant	g = 9.81	m/s^2	

Drag Force Equation $$F_D = \frac{1}{2} C_D A p_w v^2$$

Bouyancy Equation $$F_B = Vg(p_w - p_B)$$

Initial Conditions		
t_o =	0	s
v_o =	3.157	mph

ELAPSED TIME (s)	**VELOCITY AT TIME (mph)**	DRAG FORCE (N)	BOUYANCY FORCE (N)	NET FORCE (N)	DISTANCE (m)	**TOTAL DEPTH (ft)**
0	**7.1**				0.0	**0.0**
0.100	5.4	281.8	11.1	-292.9	0.28	0.9
0.200	4.3	178.8	19.7	-198.6	0.50	1.6
0.300	3.5	120.2	26.7	-147.0	0.67	2.2
0.400	2.9	83.4	32.5	-115.9	0.82	2.7
0.500	2.5	58.6	37.3	-95.9	0.94	3.1
0.600	2.1	41.1	41.4	-82.5	1.04	3.4
0.700	1.7	28.3	44.8	-73.1	1.13	3.7
0.800	1.4	18.9	47.6	-66.5	1.20	3.9
0.870	1.2	13.8	49.2	-63.0	1.24	4.1
0.900	1.1	11.9	49.8	-61.8	1.25	4.1
1.000	0.8	6.9	51.6	-58.4	1.30	4.3
1.100	0.6	3.3	52.8	-56.2	1.33	4.4
1.150	0.4	2.1	53.3	-55.4	1.34	4.4
1.200	0.3	1.1	53.7	-54.8	1.35	4.4
1.300	0.1	0.1	54.0	-54.1	1.36	4.5
1.330		0.0	54.0	-54.0	1.36	4.5

Drops Diagonally into the Pool

Height of COM	h = 1.08	m	
Mass of Person	m = 48.98	kg =	108 lb
Density of Water	p_w = 1000.00	kg/m^3	
Density of Person	p_B = 980.00	kg/m^3	
Cross-Sectional Area	A = 0.09	m^2 =	1 ft^2
Length of Person	L = 1.14	m =	3.72704199 ft
Volume of Person	V = 0.33	m^3	
Coefficient of Drag	C_D = 1.00		
Gravitational Constant	g = 9.81	m/s^2	

Drag Force Equation $$F_D = \frac{1}{2} C_D A p_w v^2$$

Bouyancy Equation $$F_B = Vg(p_w - p_B)$$

Initial Conditions		
t_o =	0	s
v_o =	3.157	mph

ELAPSED TIME (s)	**VELOCITY AT TIME (mph)**	DRAG FORCE (N)	BOUYANCY FORCE (N)	NET FORCE (N)	DISTANCE (m)	**TOTAL DEPTH (ft)**
0	**7.1**				0.0	**0.0**
0.100	5.4	280.9	15.7	-296.6	0.28	0.9
0.200	4.3	176.4	27.8	-204.2	0.49	1.6
0.300	3.5	116.3	37.6	-154.0	0.67	2.2
0.400	2.8	78.3	45.6	-123.9	0.81	2.7
0.500	2.3	52.6	52.2	-104.8	0.93	3.0
0.600	1.9	34.6	57.5	-92.1	1.02	3.4
0.700	1.5	21.7	61.8	-83.5	1.10	3.6
0.800	1.1	12.5	65.1	-77.6	1.16	3.8
0.870	0.9	7.8	66.9	-74.7	1.19	3.9
0.900	0.8	6.2	67.6	-73.7	1.20	3.9
1.000	0.5	2.2	69.1	-71.3	1.23	4.0
1.100	0.1	0.2	69.9	-70.2	1.24	4.1
1.150		0.0	70.0	-70.0	1.24	4.1
1.200						
1.300						
1.330						

Drops with Tucked Knees into the Pool

Height of COM	h = 0.91	m	
Mass of Person	m = 48.98	kg =	108 lb
Density of Water	p_w = 1000.00	kg/m^3	
Density of Person	p_B = 980.00	kg/m^3	
Cross-Sectional Area	A = 0.24	m^2 =	2.635417 ft^2
Length of Person	L = 0.80	m =	2.63541667 ft
Volume of Person	V = 0.33	m^3	
Coefficient of Drag	C_D = 1.00		
Gravitational Constant	g = 9.81	m/s^2	

Drag Force Equation $$F_D = \frac{1}{2} C_D A p_w v^2$$

Bouyancy Equation $$F_B = Vg(p_w - p_B)$$

Initial Conditions		
t_o =	0	s
v_o =	3.157	mph

ELAPSED TIME (s)	**VELOCITY AT TIME (mph)**	DRAG FORCE (N)	BOUYANCY FORCE (N)	NET FORCE (N)	DISTANCE (m)	**TOTAL DEPTH (ft)**
0	**7.1**				0.0	**0.0**
0.100	3.8	389.3	18.7	-408.0	0.24	0.8
0.200	2.6	170.8	30.0	-200.8	0.38	1.2
0.300	1.8	88.5	37.8	-126.3	0.48	1.6
0.400	1.4	48.3	43.6	-91.9	0.55	1.8
0.500	1.0	25.8	47.8	-73.6	0.60	2.0
0.600	0.7	12.5	50.8	-63.3	0.64	2.1
0.700	0.4	4.7	52.8	-57.5	0.66	2.2
0.800	0.2	0.8	53.9	-54.7	0.68	2.2
0.870		0.0	54.1	-54.1	0.68	2.2
0.900						
1.000						
1.100						
1.150						
1.200						
1.300						
1.330						

Drops Horizontally into the Pool

Height of COM	h = 0.66	m	
Mass of Person	m = 48.98	kg =	108 lb
Density of Water	p_w = 1000.00	kg/m^3	
Density of Person	p_B = 980.00	kg/m^3	
Cross-Sectional Area	A = 0.49	m^2 =	5.270833 ft^2
Length of Person	L = 0.30	m =	1 ft
Volume of Person	V = 0.33	m^3	
Coefficient of Drag	C_D = 1.00		
Gravitational Constant	g = 9.81	m/s^2	

Drag Force Equation $$F_D = \frac{1}{2} C_D A p_w v^2$$

Bouyancy Equation $$F_B = Vg(p_w - p_B)$$

Initial Conditions		
t_o =	0	s
v_o =	3.157	mph

ELAPSED TIME (s)	**VELOCITY AT TIME (mph)**	DRAG FORCE (N)	BOUYANCY FORCE (N)	NET FORCE (N)	DISTANCE (m)	**TOTAL DEPTH (ft)**
0	**7.1**				0.0	**0.0**
0.100	2.5	349.7	39.8	-389.6	0.19	0.6
0.200	1.4	107.6	57.9	-165.5	0.28	0.9
0.300	0.8	37.3	68.5	-105.8	0.33	1.1
0.400	0.4	9.6	74.4	-84.0	0.35	1.2
0.500	0.0	0.3	76.6	-76.9	0.37	1.2
0.600						
0.700						
0.800						
0.870						
0.900						
1.000						
1.100						
1.150						
1.200						
1.300						
1.330						

Drops Vertically into the Pool

Height of COM	h = 1.35	m	
Mass of Person	m = 65.31	kg =	144 lb
Density of Water	p_w = 1000.00	kg/m^3	
Density of Person	p_B = 980.00	kg/m^3	
Cross-Sectional Area	A = 0.09	m^2 =	1 ft^2
Length of Person	L = 1.69	m =	5.54166667 ft
Volume of Person	V = 0.33	m^3	
Coefficient of Drag	C_D = 1.00		
Gravitational Constant	g = 9.81	m/s^2	

Drag Force Equation $$F_D = \frac{1}{2} C_D A p_w v^2$$

Bouyancy Equation $$F_B = V g (p_w - p_B)$$

Initial Conditions		
t_o =	0	s
v_o =	3.157	mph

ELAPSED TIME (s)	**VELOCITY AT TIME (mph)**	DRAG FORCE (N)	BOUYANCY FORCE (N)	NET FORCE (N)	DISTANCE (m)	**TOTAL DEPTH (ft)**
0	**7.1**				0.0	**0.0**
0.100	5.7	316.4	10.9	-327.3	0.29	0.9
0.200	4.8	219.8	19.8	-239.5	0.52	1.7
0.300	4.1	158.7	27.3	-186.0	0.72	2.4
0.400	3.5	117.3	33.7	-151.1	0.89	2.9
0.500	3.0	87.9	39.3	-127.2	1.04	3.4
0.600	2.6	66.1	44.1	-110.2	1.17	3.8
0.700	2.3	49.6	48.3	-97.9	1.28	4.2
0.800	2.0	36.8	51.9	-88.7	1.37	4.5
0.900	1.7	26.8	55.0	-81.8	1.45	4.8
1.000	1.4	18.9	57.6	-76.5	1.52	5.0
1.100	1.1	12.7	59.8	-72.5	1.58	5.2
1.200	0.9	8.0	61.5	-69.5	1.63	5.3
1.300	0.7	4.5	62.9	-67.3	1.66	5.5
1.380	0.5	2.4	63.7	-66.1	1.68	5.5
1.400	0.4	2.0	63.8	-65.8	1.69	5.5
1.500	0.2	0.5	64.4	-65.0	1.70	5.6
1.600		0.0	64.6	-64.6	1.71	5.6

Drops Diagonally into the Pool

Height of COM	h = 1.11	m	
Mass of Person	m = 65.31	kg =	144 lb
Density of Water	p_w = 1000.00	kg/m^3	
Density of Person	p_B = 980.00	kg/m^3	
Cross-Sectional Area	A = 0.09	m^2 =	1 ft^2
Length of Person	L = 1.19	m =	3.91855008 ft
Volume of Person	V = 0.33	m^3	
Coefficient of Drag	C_D = 1.00		
Gravitational Constant	g = 9.81	m/s^2	

Drag Force Equation $$F_D = \frac{1}{2} C_D A p_w v^2$$

Bouyancy Equation $$F_B = Vg(p_w - p_B)$$

Initial Conditions		
t_o =	0	s
v_o =	3.157	mph

ELAPSED TIME (s)	**VELOCITY AT TIME (mph)**	DRAG FORCE (N)	BOUYANCY FORCE (N)	NET FORCE (N)	DISTANCE (m)	**TOTAL DEPTH (ft)**
0	**7.1**				0.0	**0.0**
0.100	5.7	315.7	15.3	-331.1	0.29	0.9
0.200	4.8	217.7	27.9	-245.6	0.52	1.7
0.300	4.0	155.1	38.5	-193.6	0.72	2.4
0.400	3.4	112.5	47.4	-159.9	0.89	2.9
0.500	2.9	81.9	55.1	-137.0	1.03	3.4
0.600	2.5	59.3	61.6	-120.9	1.15	3.8
0.700	2.1	42.2	67.1	-109.3	1.25	4.1
0.800	1.7	29.1	71.7	-100.9	1.34	4.4
0.900	1.4	19.2	75.5	-94.7	1.41	4.6
1.000	1.1	11.6	78.5	-90.2	1.47	4.8
1.100	0.8	6.2	80.8	-87.0	1.51	5.0
1.200	0.5	2.5	82.4	-84.9	1.54	5.1
1.300	0.2	0.5	83.2	-83.7	1.56	5.1
1.380		0.0	83.4	-83.4	1.56	5.1
1.400						
1.500						
1.600						

Drops with Tucked Knees into the Pool

Height of COM	h = 0.93	m	
Mass of Person	m = 65.31	kg =	144 lb
Density of Water	p_w = 1000.00	kg/m^3	
Density of Person	p_B = 980.00	kg/m^3	
Cross-Sectional Area	A = 0.26	m^2 =	2.770833 ft^2
Length of Person	L = 0.84	m =	2.77083333 ft
Volume of Person	V = 0.33	m^3	
Coefficient of Drag	C_D = 1.00		
Gravitational Constant	g = 9.81	m/s^2	

Drag Force Equation $$F_D = \frac{1}{2} C_D A p_w v^2$$

Bouyancy Equation $$F_B = Vg(p_w - p_B)$$

Initial Conditions		
t_o =	0	s
v_o =	3.157	mph

ELAPSED TIME (s)	**VELOCITY AT TIME (mph)**	DRAG FORCE (N)	BOUYANCY FORCE (N)	NET FORCE (N)	DISTANCE (m)	**TOTAL DEPTH (ft)**
0	**7.1**				0.0	**0.0**
0.100	4.2	502.0	18.8	-520.8	0.25	0.8
0.200	3.0	244.5	31.0	-275.5	0.41	1.3
0.300	2.3	137.5	39.9	-177.4	0.53	1.7
0.400	1.7	82.2	46.7	-128.9	0.62	2.0
0.500	1.4	49.8	52.0	-101.8	0.69	2.3
0.600	1.0	29.5	56.1	-85.6	0.74	2.4
0.700	0.8	16.2	59.2	-75.4	0.78	2.6
0.800	0.5	7.7	61.4	-69.1	0.81	2.7
0.900	0.3	2.6	62.8	-65.4	0.83	2.7
1.000	0.1	0.2	63.5	-63.7	0.84	2.8
1.100						
1.200						
1.300						
1.380						
1.400						
1.500						
1.600						

Drops Horizontally into the Pool

Height of COM	h = 0.66	m	
Mass of Person	m = 65.31	kg =	144 lb
Density of Water	p_w = 1000.00	kg/m^3	
Density of Person	p_B = 980.00	kg/m^3	
Cross-Sectional Area	A = 0.51	m^2 =	5.541667 ft^2
Length of Person	L = 0.30	m =	1 ft
Volume of Person	V = 0.33	m^3	
Coefficient of Drag	C_D = 1.00		
Gravitational Constant	g = 9.81	m/s^2	

Drag Force Equation $$F_D = \frac{1}{2} C_D A p_w v^2$$

Bouyancy Equation $$F_B = Vg(p_w - p_B)$$

Initial Conditions		
t_o =	0	s
v_o =	3.157	mph

ELAPSED TIME (s)	**VELOCITY AT TIME (mph)**	DRAG FORCE (N)	BOUYANCY FORCE (N)	NET FORCE (N)	DISTANCE (m)	**TOTAL DEPTH (ft)**
0	**7.1**				0.0	**0.0**
0.100	2.9	501.1	43.3	-544.4	0.21	0.7
0.200	1.8	175.2	65.2	-240.4	0.31	1.0
0.300	1.1	72.2	78.8	-151.0	0.38	1.2
0.400	0.7	27.5	87.5	-115.0	0.42	1.4
0.500	0.3	6.9	92.4	-99.3	0.44	1.4
0.600	0.0	0.1	94.1	-94.2	0.45	1.5
0.700						
0.800						
0.900						
1.000						
1.100						
1.200						
1.300						
1.380						
1.400						
1.500						
1.600						

10-year-old Boy Calculations

Drops Vertically into the Pool

Height of COM	h = 1.16	m	
Mass of Person	m = 26.30	kg =	58 lb
Density of Water	p_w = 1000.00	kg/m^3	
Density of Person	p_B = 980.00	kg/m^3	
Cross-Sectional Area	A = 0.09	m^2 =	1 ft^2
Length of Person	L = 1.30	m =	4.27083333 ft
Volume of Person	V = 0.33	m^3	
Coefficient of Drag	C_D = 1.00		
Gravitational Constant	g = 9.81	m/s^2	

Drag Force Equation $$F_D = \frac{1}{2} C_D A p_w v^2$$

Bouyancy Equation $$F_B = Vg(p_w - p_B)$$

Initial Conditions		
t_o =	0	s
v_o =	3.157	mph

ELAPSED TIME (s)	**VELOCITY AT TIME (mph)**	DRAG FORCE (N)	BOUYANCY FORCE (N)	NET FORCE (N)	DISTANCE (m)	**TOTAL DEPTH (ft)**
0	**7.1**				0.0	**0.0**
0.100	4.4	195.3	12.4	-207.7	0.25	0.8
0.200	3.1	96.7	20.7	-117.4	0.42	1.4
0.300	2.3	53.1	26.7	-79.9	0.54	1.8
0.370	1.9	35.5	30.0	-65.6	0.61	2.0
0.400	1.7	29.9	31.2	-61.1	0.64	2.1
0.500	1.3	16.1	34.6	-50.7	0.70	2.3
0.570	1.0	9.8	36.3	-46.2	0.74	2.4
0.600	0.9	7.7	37.0	-44.7	0.75	2.5
0.700	0.5	2.8	38.5	-41.3	0.79	2.6
0.730	0.4	1.8	38.8	-40.6	0.79	2.6
0.800	0.2	0.4	39.3	-39.7	0.80	2.6
0.860		0.0	39.4	-39.4	0.80	2.6

Drops Diagonally into the Pool

Height of COM	h = 0.97	m	
Mass of Person	m = 26.30	kg =	58 lb
Density of Water	p_w = 1000.00	kg/m^3	
Density of Person	p_B = 980.00	kg/m^3	
Cross-Sectional Area	A = 0.09	m^2 =	1 ft^2
Length of Person	L = 0.92	m =	3.01993521 ft
Volume of Person	V = 0.33	m^3	
Coefficient of Drag	C_D = 1.00		
Gravitational Constant	g = 9.81	m/s^2	

Drag Force Equation $$F_D = \frac{1}{2} C_D A p_w v^2$$

Bouyancy Equation $$F_B = Vg(p_w - p_B)$$

Initial Conditions		
t_o =	0	s
v_o =	3.157	mph

ELAPSED TIME (s)	**VELOCITY AT TIME (mph)**	DRAG FORCE (N)	BOUYANCY FORCE (N)	NET FORCE (N)	DISTANCE (m)	**TOTAL DEPTH (ft)**
0	**7.1**				0.0	**0.0**
0.100	4.4	193.8	17.6	-211.4	0.25	0.8
0.200	3.1	93.4	29.2	-122.6	0.42	1.4
0.300	2.2	48.7	37.4	-86.1	0.54	1.8
0.370	1.8	30.6	41.8	-72.4	0.60	2.0
0.400	1.6	24.8	43.4	-68.2	0.62	2.1
0.500	1.0	11.1	47.5	-58.6	0.68	2.2
0.570	0.7	5.3	49.5	-54.8	0.71	2.3
0.600	0.6	3.5	50.1	-53.6	0.72	2.4
0.700	0.1	0.3	51.2	-51.5	0.74	2.4
0.730		0.0	51.3	-51.3	0.74	2.4
0.800						
0.860						

Drops with Tucked Knees into the Pool

Height of COM	h = 0.83	m	
Mass of Person	m = 26.30	kg =	58 lb
Density of Water	p_w = 1000.00	kg/m^3	
Density of Person	p_B = 980.00	kg/m^3	
Cross-Sectional Area	A = 0.20	m^2 =	2.135417 ft^2
Length of Person	L = 0.65	m =	2.13541667 ft
Volume of Person	V = 0.33	m^3	
Coefficient of Drag	C_D = 1.00		
Gravitational Constant	g = 9.81	m/s^2	

Drag Force Equation $$F_D = \frac{1}{2} C_D A p_w v^2$$

Bouyancy Equation $$F_B = Vg(p_w - p_B)$$

Initial Conditions		
t_o =	0	s
v_o =	3.157	mph

ELAPSED TIME (s)	**VELOCITY AT TIME (mph)**	DRAG FORCE (N)	BOUYANCY FORCE (N)	NET FORCE (N)	DISTANCE (m)	**TOTAL DEPTH (ft)**
0	**7.1**				0.0	**0.0**
0.100	3.0	202.2	20.6	-222.7	0.21	0.7
0.200	1.8	70.2	31.0	-101.3	0.32	1.0
0.300	1.1	27.8	37.5	-65.3	0.38	1.3
0.370	0.8	13.6	40.5	-54.0	0.41	1.4
0.400	0.6	9.5	41.5	-50.9	0.42	1.4
0.500	0.2	1.6	43.5	-45.1	0.44	1.5
0.570		0.0	43.9	-43.9	0.45	1.5
0.600						
0.700						
0.730						
0.800						
0.860						

Drops Horizontally into the Pool

Height of COM	$h = 0.66$	m	
Mass of Person	$m = 26.30$	kg =	58 lb
Density of Water	$p_w = 1000.00$	kg/m^3	
Density of Person	$p_B = 980.00$	kg/m^3	
Cross-Sectional Area	$A = 0.40$	m^2 =	4.270833 ft^2
Length of Person	$L = 0.30$	m =	1 ft
Volume of Person	$V = 0.33$	m^3	
Coefficient of Drag	$C_D = 1.00$		
Gravitational Constant	$g = 9.81$	m/s^2	

Drag Force Equation $$F_D = \frac{1}{2} C_D A p_w v^2$$

Bouyancy Equation $$F_B = Vg(p_w - p_B)$$

Initial Conditions		
t_o =	0	s
v_o =	3.157	mph

ELAPSED TIME (s)	**VELOCITY AT TIME (mph)**	DRAG FORCE (N)	BOUYANCY FORCE (N)	NET FORCE (N)	DISTANCE (m)	**TOTAL DEPTH (ft)**
0	**7.1**				0.0	**0.0**
0.100	1.8	149.1	33.4	-182.4	0.16	0.5
0.200	0.8	32.8	45.5	-78.3	0.22	0.7
0.300	0.3	4.9	51.0	-55.9	0.24	0.8
0.370		0.0	52.1	-52.1	0.25	0.8
0.400						
0.500						
0.570						
0.600						
0.700						
0.730						
0.800						
0.860						

Drops Vertically into the Pool

Height of COM	$h = 1.20$	m	
Mass of Person	$m = 31.75$	kg =	70 lb
Density of Water	$p_w = 1000.00$	kg/m^3	
Density of Person	$p_B = 980.00$	kg/m^3	
Cross-Sectional Area	$A = 0.09$	m^2 =	1 ft^2
Length of Person	$L = 1.38$	m =	4.54166667 ft
Volume of Person	$V = 0.33$	m^3	
Coefficient of Drag	$C_D = 1.00$		
Gravitational Constant	$g = 9.81$	m/s^2	

Drag Force Equation $$F_D = \frac{1}{2} C_D A p_w v^2$$

Bouyancy Equation $$F_B = Vg(p_w - p_B)$$

Initial Conditions		
$t_o =$	0	s
$v_o =$	3.157	mph

ELAPSED TIME (s)	**VELOCITY AT TIME (mph)**	DRAG FORCE (N)	BOUYANCY FORCE (N)	NET FORCE (N)	DISTANCE (m)	**TOTAL DEPTH (ft)**
0	**7.1**				0.0	**0.0**
0.100	4.7	222.4	12.1	-234.5	0.26	0.9
0.200	3.5	119.6	20.6	-140.2	0.45	1.5
0.300	2.7	70.4	27.0	-97.4	0.59	1.9
0.400	2.1	42.8	32.0	-74.8	0.69	2.3
0.500	1.6	25.8	35.8	-61.6	0.78	2.5
0.600	1.2	14.7	38.8	-53.5	0.84	2.8
0.650	1.0	10.7	40.0	-50.7	0.87	2.8
0.700	0.9	7.5	41.0	-48.5	0.89	2.9
0.800	0.5	3.0	42.5	-45.5	0.92	3.0
0.840	0.4	1.8	42.9	-44.7	0.93	3.0
0.900	0.2	0.6	43.3	-43.9	0.94	3.1
0.980		0.0	43.5	-43.5	0.94	3.1

Drops Diagonally into the Pool

Height of COM	h = 1.00	m	
Mass of Person	m = 31.75	kg =	70 lb
Density of Water	p_w = 1000.00	kg/m^3	
Density of Person	p_B = 980.00	kg/m^3	
Cross-Sectional Area	A = 0.09	m^2 =	1 ft^2
Length of Person	L = 0.98	m =	3.2114433 ft
Volume of Person	V = 0.33	m^3	
Coefficient of Drag	C_D = 1.00		
Gravitational Constant	g = 9.81	m/s^2	

Drag Force Equation $$F_D = \frac{1}{2} C_D A p_w v^2$$

Bouyancy Equation $$F_B = Vg(p_w - p_B)$$

Initial Conditions		
t_o =	0	s
v_o =	3.157	mph

ELAPSED TIME (s)	**VELOCITY AT TIME (mph)**	DRAG FORCE (N)	BOUYANCY FORCE (N)	NET FORCE (N)	DISTANCE (m)	**TOTAL DEPTH (ft)**
0	**7.1**				0.0	**0.0**
0.100	4.7	221.2	17.1	-238.3	0.26	0.9
0.200	3.4	116.6	29.0	-145.6	0.44	1.5
0.300	2.6	66.0	37.9	-103.9	0.58	1.9
0.400	2.0	37.5	44.6	-82.1	0.68	2.2
0.500	1.4	20.2	49.6	-69.8	0.76	2.5
0.600	1.0	9.4	53.1	-62.6	0.81	2.7
0.650	0.7	5.8	54.4	-60.2	0.83	2.7
0.700	0.5	3.1	55.4	-58.5	0.85	2.8
0.800	0.1	0.3	56.4	-56.7	0.86	2.8
0.840		0.0	56.5	-56.5	0.87	2.8
0.900						
0.980						

Drops with Tucked Knees into the Pool

Height of COM	h = 0.85	m	
Mass of Person	m = 31.75	kg =	70 lb
Density of Water	p_w = 1000.00	kg/m^3	
Density of Person	p_B = 980.00	kg/m^3	
Cross-Sectional Area	A = 0.21	m^2 =	2.270833 ft^2
Length of Person	L = 0.69	m =	2.27083333 ft
Volume of Person	V = 0.33	m^3	
Coefficient of Drag	C_D = 1.00		
Gravitational Constant	g = 9.81	m/s^2	

Drag Force Equation $$F_D = \frac{1}{2} C_D A p_w v^2$$

Bouyancy Equation $$F_B = Vg(p_w - p_B)$$

Initial Conditions		
t_o =	0	s
v_o =	3.157	mph

ELAPSED TIME (s)	**VELOCITY AT TIME (mph)**	DRAG FORCE (N)	BOUYANCY FORCE (N)	NET FORCE (N)	DISTANCE (m)	**TOTAL DEPTH (ft)**
0	**7.1**				0.0	**0.0**
0.100	3.3	249.7	20.1	-269.8	0.22	0.7
0.200	2.0	94.0	30.9	-124.9	0.34	1.1
0.300	1.3	41.4	37.9	-79.3	0.41	1.3
0.400	0.9	17.5	42.6	-60.1	0.46	1.5
0.500	0.5	5.7	45.4	-51.1	0.49	1.6
0.600	0.1	0.6	46.8	-47.4	0.51	1.7
0.650		0.0	46.9	-46.9	0.51	1.7
0.700						
0.800						
0.840						
0.900						
0.980						

Drops Horizontally into the Pool

Height of COM	$h = 0.66$	m	
Mass of Person	$m = 31.75$	kg =	70 lb
Density of Water	$p_w = 1000.00$	kg/m^3	
Density of Person	$p_B = 980.00$	kg/m^3	
Cross-Sectional Area	$A = 0.42$	m^2 =	4.541667 ft^2
Length of Person	$L = 0.30$	m =	1 ft
Volume of Person	$V = 0.33$	m^3	
Coefficient of Drag	$C_D = 1.00$		
Gravitational Constant	$g = 9.81$	m/s^2	

Drag Force Equation $F_D = \frac{1}{2} C_D A p_w v^2$

Bouyancy Equation $F_B = V g (p_w - p_B)$

Initial Conditions		
$t_o =$	0	s
$v_o =$	3.157	mph

ELAPSED TIME (s)	**VELOCITY AT TIME (mph)**	DRAG FORCE (N)	BOUYANCY FORCE (N)	NET FORCE (N)	DISTANCE (m)	**TOTAL DEPTH (ft)**
0	**7.1**				0.0	**0.0**
0.100	2.0	196.0	35.4	-231.4	0.17	0.6
0.200	1.0	48.8	49.3	-98.1	0.24	0.8
0.300	0.5	10.7	56.2	-67.0	0.27	0.9
0.400	0.0	0.2	58.7	-58.9	0.28	0.9
0.500						
0.600						
0.650						
0.700						
0.800						
0.840						
0.900						
0.980						

Drops Vertically into the Pool

Height of COM	$h =$ 1.24	m	
Mass of Person	$m =$ 41.72	kg =	92 lb
Density of Water	$p_w =$ 1000.00	kg/m^3	
Density of Person	$p_B =$ 980.00	kg/m^3	
Cross-Sectional Area	$A =$ 0.09	m^2 =	1 ft^2
Length of Person	$L =$ 1.47	m =	4.83333333 ft
Volume of Person	$V =$ 0.33	m^3	
Coefficient of Drag	$C_D =$ 1.00		
Gravitational Constant	$g =$ 9.81	m/s^2	

Drag Force Equation $$F_D = \frac{1}{2} C_D A p_w v^2$$

Bouyancy Equation $$F_B = Vg(p_w - p_B)$$

Initial Conditions		
$t_o =$	0	s
$v_o =$	3.157	mph

ELAPSED TIME (s)	**VELOCITY AT TIME (mph)**	DRAG FORCE (N)	BOUYANCY FORCE (N)	NET FORCE (N)	DISTANCE (m)	**TOTAL DEPTH (ft)**
0	**7.1**				0.0	**0.0**
0.100	5.2	260.6	11.8	-272.4	0.27	0.9
0.200	4.0	156.0	20.8	-176.8	0.48	1.6
0.300	3.2	100.0	27.8	-127.8	0.64	2.1
0.400	2.6	66.3	33.5	-99.7	0.77	2.5
0.480	2.2	48.0	37.3	-85.2	0.86	2.8
0.500	2.1	44.2	38.1	-82.3	0.88	2.9
0.600	1.7	29.1	41.9	-71.0	0.97	3.2
0.700	1.4	18.4	44.9	-63.4	1.04	3.4
0.770	1.1	12.9	46.7	-59.6	1.08	3.5
0.800	1.1	10.9	47.3	-58.2	1.09	3.6
0.900	0.8	5.6	49.1	-54.7	1.13	3.7
1.000	0.5	2.2	50.3	-52.5	1.16	3.8
1.010	0.4	2.0	50.4	-52.4	1.16	3.8
1.100	0.2	0.4	51.0	-51.4	1.17	3.9
1.170		0.0	51.1	-51.1	1.18	3.9

Drops Diagonally into the Pool

Height of COM	h = 1.03	m	
Mass of Person	m = 41.72	kg =	92 lb
Density of Water	p_w = 1000.00	kg/m^3	
Density of Person	p_B = 980.00	kg/m^3	
Cross-Sectional Area	A = 0.09	m^2 =	1 ft^2
Length of Person	L = 1.04	m =	3.41768278 ft
Volume of Person	V = 0.33	m^3	
Coefficient of Drag	C_D = 1.00		
Gravitational Constant	g = 9.81	m/s^2	

Drag Force Equation $$F_D = \frac{1}{2} C_D A p_w v^2$$

Bouyancy Equation $$F_B = Vg(p_w - p_B)$$

Initial Conditions		
t_o =	0	s
v_o =	3.157	mph

ELAPSED TIME (s)	**VELOCITY AT TIME (mph)**	DRAG FORCE (N)	BOUYANCY FORCE (N)	NET FORCE (N)	DISTANCE (m)	**TOTAL DEPTH (ft)**
0	**7.1**				0.0	**0.0**
0.100	5.1	259.5	16.7	-276.3	0.27	0.9
0.200	4.0	153.2	29.3	-182.5	0.48	1.6
0.300	3.1	95.8	39.1	-134.9	0.64	2.1
0.400	2.5	60.9	46.9	-107.7	0.76	2.5
0.480	2.1	42.0	51.9	-93.9	0.85	2.8
0.500	2.0	38.1	53.1	-91.2	0.87	2.8
0.600	1.5	22.7	57.9	-80.6	0.94	3.1
0.700	1.1	12.3	61.6	-73.9	1.00	3.3
0.770	0.8	7.2	63.5	-70.6	1.03	3.4
0.800	0.7	5.4	64.1	-69.6	1.05	3.4
0.900	0.4	1.5	65.7	-67.2	1.07	3.5
1.000	0.0	0.0	66.2	-66.2	1.08	3.5
1.010		0.0	66.2	-66.2	1.08	3.5
1.100						
1.170						

Drops with Tucked Knees into the Pool

Height of COM	h = 0.88	m	
Mass of Person	m = 41.72	kg =	92 lb
Density of Water	p_w = 1000.00	kg/m^3	
Density of Person	p_B = 980.00	kg/m^3	
Cross-Sectional Area	A = 0.22	m^2 =	2.416667 ft^2
Length of Person	L = 0.74	m =	2.41666667 ft
Volume of Person	V = 0.33	m^3	
Coefficient of Drag	C_D = 1.00		
Gravitational Constant	g = 9.81	m/s^2	

Drag Force Equation $$F_D = \frac{1}{2} C_D A p_w v^2$$

Bouyancy Equation $$F_B = Vg(p_W - p_B)$$

Initial Conditions		
t_o =	0	s
v_o =	3.157	mph

ELAPSED TIME (s)	**VELOCITY AT TIME (mph)**	DRAG FORCE (N)	BOUYANCY FORCE (N)	NET FORCE (N)	DISTANCE (m)	**TOTAL DEPTH (ft)**
0	**7.1**				0.0	**0.0**
0.100	3.7	331.9	20.0	-351.9	0.23	0.8
0.200	2.4	139.3	31.8	-171.1	0.37	1.2
0.300	1.7	68.7	39.7	-108.4	0.46	1.5
0.400	1.2	34.8	45.4	-80.2	0.52	1.7
0.480	0.9	19.3	48.7	-68.0	0.56	1.8
0.500	0.8	16.4	49.4	-65.7	0.57	1.9
0.600	0.5	6.1	52.0	-58.1	0.60	2.0
0.700	0.2	1.1	53.3	-54.4	0.61	2.0
0.770		0.0	53.6	-53.6	0.62	2.0
0.800						
0.900						
1.000						
1.010						
1.100						
1.170						

Drops Horizontally into the Pool

Height of COM	h = 0.66	m	
Mass of Person	m = 41.72	kg =	92 lb
Density of Water	p_w = 1000.00	kg/m^3	
Density of Person	p_B = 980.00	kg/m^3	
Cross-Sectional Area	A = 0.45	m^2 =	4.833333 ft^2
Length of Person	L = 0.30	m =	1 ft
Volume of Person	V = 0.33	m^3	
Coefficient of Drag	C_D = 1.00		
Gravitational Constant	g = 9.81	m/s^2	

Drag Force Equation $$F_D = \frac{1}{2} C_D A p_w v^2$$

Bouyancy Equation $$F_B = Vg(p_w - p_B)$$

Initial Conditions		
t_o =	0	s
v_o =	3.157	mph

ELAPSED TIME (s)	**VELOCITY AT TIME (mph)**	DRAG FORCE (N)	BOUYANCY FORCE (N)	NET FORCE (N)	DISTANCE (m)	**TOTAL DEPTH (ft)**
0	**7.1**				0.0	**0.0**
0.100	2.4	287.9	38.7	-326.6	0.18	0.6
0.200	1.3	83.4	55.6	-139.0	0.27	0.9
0.300	0.7	25.8	65.0	-90.8	0.31	1.0
0.400	0.3	4.5	69.8	-74.4	0.33	1.1
0.480		0.0	70.9	-70.9	0.34	1.1
0.500						
0.600						
0.700						
0.770						
0.800						
0.900						
1.000						
1.010						
1.100						
1.170						

12-year-old Boy Calculations

Drops Vertically into the Pool

Height of COM	$h = 1.21$	m	
Mass of Person	$m = 32.20$	kg =	71 lb
Density of Water	$p_w = 1000.00$	kg/m^3	
Density of Person	$p_B = 980.00$	kg/m^3	
Cross-Sectional Area	$A = 0.09$	$m^2 =$	1 ft^2
Length of Person	$L = 1.40$	m =	4.58333333 ft
Volume of Person	$V = 0.33$	m^3	
Coefficient of Drag	$C_D = 1.00$		
Gravitational Constant	$g = 9.81$	m/s^2	

Drag Force Equation $$F_D = \frac{1}{2} C_D A p_w v^2$$

Bouyancy Equation $$F_B = Vg(p_w - p_B)$$

Initial Conditions		
$t_o =$	0	s
$v_o =$	3.157	mph

ELAPSED TIME (s)	**VELOCITY AT TIME (mph)**	DRAG FORCE (N)	BOUYANCY FORCE (N)	NET FORCE (N)	DISTANCE (m)	**TOTAL DEPTH (ft)**
0	**7.1**				0.0	**0.0**
0.100	4.8	224.5	12.0	-236.5	0.26	0.9
0.200	3.5	121.5	20.5	-142.0	0.45	1.5
0.300	2.7	71.9	26.9	-98.8	0.59	1.9
0.400	2.1	43.9	31.9	-75.8	0.70	2.3
0.410	2.1	41.8	32.3	-74.2	0.71	2.3
0.500	1.7	26.7	35.8	-62.4	0.78	2.6
0.600	1.3	15.4	38.8	-54.2	0.85	2.8
0.650	1.1	11.3	40.0	-51.3	0.87	2.9
0.700	0.9	8.0	41.0	-49.0	0.90	2.9
0.800	0.6	3.3	42.5	-45.9	0.93	3.1
0.850	0.4	1.8	43.0	-44.9	0.94	3.1
0.900	0.3	0.8	43.4	-44.2	0.95	3.1
0.990		0.0	43.6	-43.7	0.95	3.1
1.000						

Drops Diagonally into the Pool

Height of COM	h = 1.00	m	
Mass of Person	m = 32.20	kg =	71 lb
Density of Water	p_w = 1000.00	kg/m^3	
Density of Person	p_B = 980.00	kg/m^3	
Cross-Sectional Area	A = 0.09	m^2 =	1 ft^2
Length of Person	L = 0.99	m =	3.24090608 ft
Volume of Person	V = 0.33	m^3	
Coefficient of Drag	C_D = 1.00		
Gravitational Constant	g = 9.81	m/s^2	

Drag Force Equation $$F_D = \frac{1}{2} C_D A p_w v^2$$

Bouyancy Equation $$F_B = Vg(p_w - p_B)$$

Initial Conditions		
t_o =	0	s
v_o =	3.157	mph

ELAPSED TIME (s)	**VELOCITY AT TIME (mph)**	DRAG FORCE (N)	BOUYANCY FORCE (N)	NET FORCE (N)	DISTANCE (m)	**TOTAL DEPTH (ft)**
0	**7.1**				0.0	**0.0**
0.100	4.7	223.2	17.0	-240.2	0.26	0.9
0.200	3.5	118.4	28.9	-147.3	0.45	1.5
0.300	2.6	67.5	37.8	-105.3	0.58	1.9
0.400	2.0	38.7	44.5	-83.2	0.69	2.3
0.410	1.9	36.5	45.0	-81.6	0.70	2.3
0.500	1.5	21.1	49.5	-70.6	0.77	2.5
0.600	1.0	10.1	53.1	-63.2	0.82	2.7
0.650	0.8	6.3	54.4	-60.8	0.84	2.8
0.700	0.6	3.5	55.4	-59.0	0.86	2.8
0.800	0.2	0.4	56.6	-57.0	0.87	2.9
0.850		0.0	56.7	-56.7	0.88	2.9
0.900						
0.990						
1.000						

Drops with Tucked Knees into the Pool

Height of COM	h = 0.86	m	
Mass of Person	m = 32.20	kg =	71 lb
Density of Water	p_w = 1000.00	kg/m^3	
Density of Person	p_B = 980.00	kg/m^3	
Cross-Sectional Area	A = 0.21	m^2 =	2.291667 ft^2
Length of Person	L = 0.70	m =	2.29166667 ft
Volume of Person	V = 0.33	m^3	
Coefficient of Drag	C_D = 1.00		
Gravitational Constant	g = 9.81	m/s^2	

Drag Force Equation $$F_D = \frac{1}{2} C_D A p_w v^2$$

Bouyancy Equation $$F_B = Vg(p_w - p_B)$$

Initial Conditions		
t_o =	0	s
v_o =	3.157	mph

ELAPSED TIME (s)	**VELOCITY AT TIME (mph)**	DRAG FORCE (N)	BOUYANCY FORCE (N)	NET FORCE (N)	DISTANCE (m)	**TOTAL DEPTH (ft)**
0	**7.1**				0.0	**0.0**
0.100	3.3	253.6	20.0	-273.5	0.22	0.7
0.200	2.0	95.8	30.7	-126.6	0.34	1.1
0.300	1.4	42.5	37.7	-80.2	0.41	1.4
0.400	0.9	18.2	42.3	-60.6	0.46	1.5
0.410	0.8	16.6	42.7	-59.3	0.47	1.5
0.500	0.5	6.2	45.2	-51.4	0.49	1.6
0.600	0.2	0.8	46.7	-47.5	0.51	1.7
0.650		0.0	46.9	-46.9	0.51	1.7
0.700						
0.800						
0.850						
0.900						
0.990						
1.000						

Drops Horizontally into the Pool

Height of COM	h = 0.66	m	
Mass of Person	m = 32.20	kg =	71 lb
Density of Water	p_w = 1000.00	kg/m^3	
Density of Person	p_B = 980.00	kg/m^3	
Cross-Sectional Area	A = 0.43	m^2 =	4.583333 ft^2
Length of Person	L = 0.30	m =	1 ft
Volume of Person	V = 0.33	m^3	
Coefficient of Drag	C_D = 1.00		
Gravitational Constant	g = 9.81	m/s^2	

Drag Force Equation $F_D = \frac{1}{2} C_D A p_w v^2$

Bouyancy Equation $F_B = V g (p_W - p_B)$

Initial Conditions		
t_o =	0	s
v_o =	3.157	mph

ELAPSED TIME (s)	**VELOCITY AT TIME (mph)**	DRAG FORCE (N)	BOUYANCY FORCE (N)	NET FORCE (N)	DISTANCE (m)	**TOTAL DEPTH (ft)**
0	**7.1**				0.0	**0.0**
0.100	2.0	199.5	35.5	-235.0	0.17	0.6
0.200	1.0	50.0	49.5	-99.4	0.24	0.8
0.300	0.5	11.2	56.5	-67.7	0.27	0.9
0.400	0.0	0.3	59.0	-59.3	0.28	0.9
0.410		0.1	59.0	-59.1	0.28	0.9
0.500						
0.600						
0.650						
0.700						
0.800						
0.850						
0.900						
0.990						
1.000						

Drops Vertically into the Pool

Height of COM	h = 1.25	m	
Mass of Person	m = 40.36	kg =	89 lb
Density of Water	p_w = 1000.00	kg/m^3	
Density of Person	p_B = 980.00	kg/m^3	
Cross-Sectional Area	A = 0.09	m^2 =	1 ft^2
Length of Person	L = 1.49	m =	4.89583333 ft
Volume of Person	V = 0.33	m^3	
Coefficient of Drag	C_D = 1.00		
Gravitational Constant	g = 9.81	m/s^2	

Drag Force Equation $$F_D = \frac{1}{2} C_D A p_w v^2$$

Bouyancy Equation $$F_B = Vg(p_w - p_B)$$

Initial Conditions		
t_o =	0	s
v_o =	3.157	mph

ELAPSED TIME (s)	**VELOCITY AT TIME (mph)**	DRAG FORCE (N)	BOUYANCY FORCE (N)	NET FORCE (N)	DISTANCE (m)	**TOTAL DEPTH (ft)**
0	**7.1**				0.0	**0.0**
0.100	5.1	256.1	11.6	-267.8	0.27	0.9
0.200	3.9	151.6	20.3	-171.9	0.47	1.6
0.300	3.2	96.4	27.2	-123.5	0.63	2.1
0.400	2.6	63.4	32.7	-96.0	0.76	2.5
0.470	2.2	47.5	35.9	-83.4	0.84	2.8
0.500	2.1	42.0	37.1	-79.1	0.87	2.8
0.600	1.7	27.4	40.8	-68.1	0.95	3.1
0.700	1.3	17.1	43.7	-60.8	1.02	3.3
0.760	1.1	12.5	45.1	-57.6	1.05	3.5
0.800	1.0	9.9	45.9	-55.9	1.07	3.5
0.900	0.7	5.0	47.6	-52.6	1.11	3.6
0.990	0.4	2.1	48.6	-50.7	1.14	3.7
1.000	0.4	1.9	48.7	-50.6	1.14	3.7
1.100	0.1	0.3	49.3	-49.5	1.15	3.8
1.160		0.0	49.3	-49.3	1.15	3.8

Drops Diagonally into the Pool

Height of COM	h = 1.04	m	
Mass of Person	m = 40.36	kg =	89 lb
Density of Water	p_w = 1000.00	kg/m^3	
Density of Person	p_B = 980.00	kg/m^3	
Cross-Sectional Area	A = 0.09	m^2 =	1 ft^2
Length of Person	L = 1.06	m =	3.46187695 ft
Volume of Person	V = 0.33	m^3	
Coefficient of Drag	C_D = 1.00		
Gravitational Constant	g = 9.81	m/s^2	

Drag Force Equation $$F_D = \frac{1}{2} C_D A p_w v^2$$

Bouyancy Equation $$F_B = Vg(p_W - p_B)$$

Initial Conditions		
t_o =	0	s
v_o =	3.157	mph

ELAPSED TIME (s)	**VELOCITY AT TIME (mph)**	DRAG FORCE (N)	BOUYANCY FORCE (N)	NET FORCE (N)	DISTANCE (m)	**TOTAL DEPTH (ft)**
0	**7.1**				0.0	**0.0**
0.100	5.1	255.1	16.5	-271.5	0.27	0.9
0.200	3.9	148.8	28.7	-177.5	0.47	1.6
0.300	3.1	92.2	38.2	-130.4	0.63	2.1
0.400	2.4	58.1	45.7	-103.8	0.76	2.5
0.470	2.1	41.7	50.0	-91.8	0.83	2.7
0.500	1.9	36.0	51.7	-87.7	0.85	2.8
0.600	1.5	21.2	56.3	-77.5	0.93	3.1
0.700	1.1	11.2	59.8	-71.0	0.99	3.2
0.760	0.8	7.0	61.3	-68.3	1.01	3.3
0.800	0.7	4.8	62.2	-66.9	1.03	3.4
0.900	0.3	1.2	63.6	-64.7	1.05	3.4
0.990		0.0	64.0	-64.0	1.06	3.5
1.000						
1.100						
1.160						

Drops with Tucked Knees into the Pool

Height of COM	h = 0.88	m	
Mass of Person	m = 40.36	kg =	89 lb
Density of Water	p_w = 1000.00	kg/m^3	
Density of Person	p_B = 980.00	kg/m^3	
Cross-Sectional Area	A = 0.23	m^2 =	2.447917 ft^2
Length of Person	L = 0.75	m =	2.44791667 ft
Volume of Person	V = 0.33	m^3	
Coefficient of Drag	C_D = 1.00		
Gravitational Constant	g = 9.81	m/s^2	

Drag Force Equation $$F_D = \frac{1}{2} C_D A p_w v^2$$

Bouyancy Equation $$F_B = V g (p_w - p_B)$$

Initial Conditions		
t_o =	0	s
v_o =	3.157	mph

ELAPSED TIME (s)	**VELOCITY AT TIME (mph)**	DRAG FORCE (N)	BOUYANCY FORCE (N)	NET FORCE (N)	DISTANCE (m)	**TOTAL DEPTH (ft)**
0	**7.1**				0.0	**0.0**
0.100	3.6	321.4	19.6	-341.0	0.23	0.7
0.200	2.3	132.5	30.8	-163.3	0.36	1.2
0.300	1.6	64.5	38.4	-102.9	0.45	1.5
0.400	1.1	32.2	43.8	-76.0	0.51	1.7
0.470	0.9	19.0	46.5	-65.5	0.54	1.8
0.500	0.8	14.8	47.5	-62.3	0.55	1.8
0.600	0.5	5.3	49.9	-55.2	0.58	1.9
0.700	0.2	0.8	51.1	-51.9	0.60	2.0
0.760		0.0	51.3	-51.3	0.60	2.0
0.800						
0.900						
0.990						
1.000						
1.100						
1.160						

Drops Horizontally into the Pool

Height of COM	$h = 0.66$	m	
Mass of Person	$m = 40.36$	kg =	89 lb
Density of Water	$p_w = 1000.00$	kg/m^3	
Density of Person	$p_B = 980.00$	kg/m^3	
Cross-Sectional Area	$A = 0.45$	m^2 =	4.895833 ft^2
Length of Person	$L = 0.30$	m =	1 ft
Volume of Person	$V = 0.33$	m^3	
Coefficient of Drag	$C_D = 1.00$		
Gravitational Constant	$g = 9.81$	m/s^2	

Drag Force Equation $$F_D = \frac{1}{2} C_D A p_w v^2$$

Bouyancy Equation $$F_B = V g (p_w - p_B)$$

Initial Conditions		
t_o =	0	s
v_o =	3.157	mph

ELAPSED TIME (s)	**VELOCITY AT TIME (mph)**	DRAG FORCE (N)	BOUYANCY FORCE (N)	NET FORCE (N)	DISTANCE (m)	**TOTAL DEPTH (ft)**
0	**7.1**				0.0	**0.0**
0.100	2.3	273.1	38.0	-311.0	0.18	0.6
0.200	1.2	77.3	54.3	-131.5	0.26	0.8
0.300	0.7	23.0	63.2	-86.2	0.30	1.0
0.400	0.2	3.5	67.6	-71.1	0.32	1.1
0.470		0.0	68.4	-68.4	0.33	1.1
0.500						
0.600						
0.700						
0.760						
0.800						
0.900						
0.990						
1.000						
1.100						
1.160						

Drops Vertically into the Pool

Height of COM	h = 1.30	m	
Mass of Person	m = 53.51	kg =	118 lb
Density of Water	p_w = 1000.00	kg/m^3	
Density of Person	p_B = 980.00	kg/m^3	
Cross-Sectional Area	A = 0.09	m^2 =	1 ft^2
Length of Person	L = 1.59	m =	5.22916667 ft
Volume of Person	V = 0.33	m^3	
Coefficient of Drag	C_D = 1.00		
Gravitational Constant	g = 9.81	m/s^2	

Drag Force Equation $$F_D = \frac{1}{2} C_D A p_w v^2$$

Bouyancy Equation $$F_B = Vg(p_w - p_B)$$

Initial Conditions		
t_o =	0	s
v_o =	3.157	mph

ELAPSED TIME (s)	**VELOCITY AT TIME (mph)**	DRAG FORCE (N)	BOUYANCY FORCE (N)	NET FORCE (N)	DISTANCE (m)	**TOTAL DEPTH (ft)**
0	**7.1**				0.0	**0.0**
0.100	5.5	292.9	11.3	-304.2	0.28	0.9
0.200	4.5	191.3	20.2	-211.5	0.50	1.7
0.300	3.7	131.5	27.6	-159.0	0.69	2.3
0.400	3.1	93.0	33.7	-126.7	0.84	2.8
0.500	2.6	66.6	38.9	-105.4	0.97	3.2
0.540	2.5	58.3	40.7	-99.0	1.02	3.3
0.600	2.2	47.7	43.3	-90.9	1.08	3.5
0.700	1.9	33.7	47.0	-80.7	1.17	3.8
0.800	1.6	23.3	50.0	-73.3	1.25	4.1
0.900	1.3	15.4	52.6	-68.0	1.31	4.3
0.910	1.2	14.7	52.8	-67.5	1.32	4.3
1.000	1.0	9.5	54.6	-64.1	1.36	4.5
1.100	0.7	5.2	56.2	-61.4	1.40	4.6
1.200	0.5	2.3	57.3	-59.6	1.43	4.7
1.300	0.2	0.6	57.9	-58.5	1.44	4.7
1.400		0.0	58.1	-58.1	1.45	4.8

Drops Diagonally into the Pool

Height of COM	h = 1.07	m	
Mass of Person	m = 53.51	kg =	118 lb
Density of Water	p_w = 1000.00	kg/m^3	
Density of Person	p_B = 980.00	kg/m^3	
Cross-Sectional Area	A = 0.09	m^2 =	1 ft^2
Length of Person	L = 1.13	m =	3.69757921 ft
Volume of Person	V = 0.33	m^3	
Coefficient of Drag	C_D = 1.00		
Gravitational Constant	g = 9.81	m/s^2	

Drag Force Equation $$F_D = \frac{1}{2} C_D A p_w v^2$$

Bouyancy Equation $$F_B = Vg(p_w - p_B)$$

Initial Conditions		
t_o =	0	s
v_o =	3.157	mph

ELAPSED TIME (s)	**VELOCITY AT TIME (mph)**	DRAG FORCE (N)	BOUYANCY FORCE (N)	NET FORCE (N)	DISTANCE (m)	**TOTAL DEPTH (ft)**
0	**7.1**				0.0	**0.0**
0.100	5.5	292.0	15.9	-308.0	0.28	0.9
0.200	4.4	188.9	28.5	-217.5	0.50	1.7
0.300	3.6	127.6	38.8	-166.4	0.68	2.2
0.400	3.0	87.8	47.3	-135.1	0.83	2.7
0.500	2.5	60.5	54.3	-114.8	0.96	3.1
0.540	2.3	51.9	56.8	-108.7	1.00	3.3
0.600	2.1	40.9	60.2	-101.1	1.06	3.5
0.700	1.7	26.7	64.9	-91.6	1.15	3.8
0.800	1.3	16.3	68.7	-85.0	1.21	4.0
0.900	0.9	8.9	71.6	-80.5	1.26	4.1
0.910	0.9	8.3	71.8	-80.1	1.27	4.2
1.000	0.6	3.9	73.6	-77.5	1.30	4.3
1.100	0.3	1.0	74.8	-75.8	1.32	4.3
1.200		0.0	75.2	-75.2	1.33	4.4
1.300						
1.400						

Drops with Tucked Knees into the Pool

Height of COM	h = 0.91	m	
Mass of Person	m = 53.51	kg =	118 lb
Density of Water	p_w = 1000.00	kg/m^3	
Density of Person	p_B = 980.00	kg/m^3	
Cross-Sectional Area	A = 0.24	m^2 =	2.614583 ft^2
Length of Person	L = 0.80	m =	2.61458333 ft
Volume of Person	V = 0.33	m^3	
Coefficient of Drag	C_D = 1.00		
Gravitational Constant	g = 9.81	m/s^2	

Drag Force Equation $$F_D = \frac{1}{2} C_D A p_w v^2$$

Bouyancy Equation $$F_B = Vg(p_w - p_B)$$

Initial Conditions		
t_o =	0	s
v_o =	3.157	mph

ELAPSED TIME (s)	**VELOCITY AT TIME (mph)**	DRAG FORCE (N)	BOUYANCY FORCE (N)	NET FORCE (N)	DISTANCE (m)	**TOTAL DEPTH (ft)**
0	**7.1**				0.0	**0.0**
0.100	4.0	420.9	19.3	-440.2	0.24	0.8
0.200	2.7	192.3	31.3	-223.6	0.39	1.3
0.300	2.0	102.6	39.8	-142.4	0.50	1.6
0.400	1.5	57.7	46.1	-103.8	0.58	1.9
0.500	1.1	32.2	50.8	-83.0	0.63	2.1
0.540	1.0	25.1	52.4	-77.4	0.65	2.1
0.600	0.8	16.7	54.3	-71.0	0.68	2.2
0.700	0.5	7.3	56.7	-64.0	0.71	2.3
0.800	0.3	2.0	58.2	-60.2	0.73	2.4
0.900	0.0	0.0	58.7	-58.7	0.73	2.4
0.910		0.0	58.7	-58.7	0.73	2.4
1.000						
1.100						
1.200						
1.300						
1.400						

Drops Horizontally into the Pool

Height of COM	h = 0.66	m	
Mass of Person	m = 53.51	kg =	118 lb
Density of Water	p_w = 1000.00	kg/m^3	
Density of Person	p_B = 980.00	kg/m^3	
Cross-Sectional Area	A = 0.49	m^2 =	5.229167 ft^2
Length of Person	L = 0.30	m =	1 ft
Volume of Person	V = 0.33	m^3	
Coefficient of Drag	C_D = 1.00		
Gravitational Constant	g = 9.81	m/s^2	

Drag Force Equation $$F_D = \frac{1}{2} C_D A p_w v^2$$

Bouyancy Equation $$F_B = Vg(p_w - p_B)$$

Initial Conditions		
t_o =	0	s
v_o =	3.157	mph

ELAPSED TIME (s)	**VELOCITY AT TIME (mph)**	DRAG FORCE (N)	BOUYANCY FORCE (N)	NET FORCE (N)	DISTANCE (m)	**TOTAL DEPTH (ft)**
0	**7.1**				0.0	**0.0**
0.100	2.7	394.8	41.3	-436.1	0.20	0.6
0.200	1.5	127.5	60.8	-188.4	0.29	1.0
0.300	0.9	47.3	72.5	-119.8	0.35	1.1
0.400	0.5	14.3	79.4	-93.7	0.38	1.2
0.500	0.1	1.5	82.5	-84.0	0.39	1.3
0.540		0.1	82.9	-82.9	0.40	1.3
0.600						
0.700						
0.800						
0.900						
0.910						
1.000						
1.100						
1.200						
1.300						
1.400						

14-year-old Boy Calculations

Drops Vertically into the Pool

Height of COM	h = 1.28	m	
Mass of Person	m = 40.36	kg =	89 lb
Density of Water	p_w = 1000.00	kg/m^3	
Density of Person	p_B = 980.00	kg/m^3	
Cross-Sectional Area	A = 0.09	m^2 =	1 ft^2
Length of Person	L = 1.54	m =	5.04166667 ft
Volume of Person	V = 0.33	m^3	
Coefficient of Drag	C_D = 1.00		
Gravitational Constant	g = 9.81	m/s^2	

Drag Force Equation $$F_D = \frac{1}{2} C_D A p_w v^2$$

Bouyancy Equation $$F_B = Vg(p_w - p_B)$$

Initial Conditions		
t_o =	0	s
v_o =	3.157	mph

ELAPSED TIME (s)	**VELOCITY AT TIME (mph)**	DRAG FORCE (N)	BOUYANCY FORCE (N)	NET FORCE (N)	DISTANCE (m)	**TOTAL DEPTH (ft)**
0	**7.1**				0.0	**0.0**
0.100	5.1	256.2	11.3	-267.5	0.27	0.9
0.200	3.9	151.8	19.7	-171.5	0.48	1.6
0.300	3.2	96.7	26.4	-123.1	0.63	2.1
0.400	2.6	63.7	31.7	-95.5	0.76	2.5
0.470	2.2	47.9	34.9	-82.8	0.84	2.8
0.500	2.1	42.4	36.1	-78.5	0.87	2.8
0.600	1.7	27.8	39.7	-67.5	0.95	3.1
0.700	1.3	17.6	42.5	-60.1	1.02	3.4
0.770	1.1	12.3	44.1	-56.4	1.06	3.5
0.800	1.0	10.4	44.7	-55.1	1.08	3.5
0.900	0.7	5.4	46.4	-51.8	1.12	3.7
1.000	0.5	2.1	47.5	-49.7	1.14	3.7
1.010	0.4	1.9	47.6	-49.5	1.14	3.8
1.100	0.2	0.4	48.1	-48.5	1.16	3.8
1.110	0.2	0.3	48.2	-48.5	1.16	3.8
1.170		0.0	48.3	-48.3	1.16	3.8

Drops Diagonally into the Pool

Height of COM	h = 1.05	m	
Mass of Person	m = 40.36	kg =	89 lb
Density of Water	p_w = 1000.00	kg/m^3	
Density of Person	p_B = 980.00	kg/m^3	
Cross-Sectional Area	A = 0.09	m^2 =	1 ft^2
Length of Person	L = 1.09	m =	3.56499669 ft
Volume of Person	V = 0.33	m^3	
Coefficient of Drag	C_D = 1.00		
Gravitational Constant	g = 9.81	m/s^2	

Drag Force Equation $$F_D = \frac{1}{2} C_D A p_w v^2$$

Bouyancy Equation $$F_B = Vg(p_w - p_B)$$

Initial Conditions		
t_o =	0	s
v_o =	3.157	mph

ELAPSED TIME (s)	**VELOCITY AT TIME (mph)**	DRAG FORCE (N)	BOUYANCY FORCE (N)	NET FORCE (N)	DISTANCE (m)	**TOTAL DEPTH (ft)**
0	**7.1**				0.0	**0.0**
0.100	5.1	255.2	16.0	-271.2	0.27	0.9
0.200	3.9	149.1	27.9	-177.0	0.47	1.6
0.300	3.1	92.6	37.1	-129.7	0.63	2.1
0.400	2.5	58.6	44.4	-103.0	0.76	2.5
0.470	2.1	42.3	48.7	-90.9	0.83	2.7
0.500	1.9	36.6	50.3	-86.8	0.85	2.8
0.600	1.5	21.8	54.8	-76.6	0.93	3.1
0.700	1.1	11.7	58.2	-70.0	0.99	3.2
0.770	0.8	6.8	60.0	-66.9	1.02	3.3
0.800	0.7	5.2	60.6	-65.8	1.03	3.4
0.900	0.4	1.4	62.1	-63.5	1.06	3.5
1.000	0.0	0.0	62.6	-62.6	1.06	3.5
1.010		0.0	62.6	-62.6	1.06	3.5
1.100						
1.110						
1.170						

Drops with Tucked Knees into the Pool

Height of COM	h = 0.89	m	
Mass of Person	m = 40.36	kg =	89 lb
Density of Water	p_w = 1000.00	kg/m^3	
Density of Person	p_B = 980.00	kg/m^3	
Cross-Sectional Area	A = 0.23	m^2 =	2.520833 ft^2
Length of Person	L = 0.77	m =	2.52083333 ft
Volume of Person	V = 0.33	m^3	
Coefficient of Drag	C_D = 1.00		
Gravitational Constant	g = 9.81	m/s^2	

Drag Force Equation $$F_D = \frac{1}{2} C_D A p_w v^2$$

Bouyancy Equation $$F_B = Vg(p_w - p_B)$$

Initial Conditions		
t_o =	0	s
v_o =	3.157	mph

ELAPSED TIME (s)	**VELOCITY AT TIME (mph)**	DRAG FORCE (N)	BOUYANCY FORCE (N)	NET FORCE (N)	DISTANCE (m)	**TOTAL DEPTH (ft)**
0	**7.1**				0.0	**0.0**
0.100	3.5	321.8	18.8	-340.6	0.23	0.7
0.200	2.3	131.5	29.6	-161.1	0.36	1.2
0.300	1.6	63.9	36.8	-100.7	0.44	1.5
0.400	1.1	32.0	41.9	-74.0	0.50	1.7
0.470	0.9	19.0	44.6	-63.6	0.54	1.8
0.500	0.8	14.9	45.5	-60.4	0.55	1.8
0.600	0.5	5.5	47.8	-53.3	0.57	1.9
0.700	0.2	0.9	49.0	-49.9	0.59	1.9
0.770		0.0	49.2	-49.2	0.59	1.9
0.800						
0.900						
1.000						
1.010						
1.100						
1.110						
1.170						

Drops Horizontally into the Pool

Height of COM	h = 0.66	m	
Mass of Person	m = 40.36	kg =	89 lb
Density of Water	p_w = 1000.00	kg/m^3	
Density of Person	p_B = 980.00	kg/m^3	
Cross-Sectional Area	A = 0.47	m^2 =	5.041667 ft^2
Length of Person	L = 0.30	m =	1 ft
Volume of Person	V = 0.33	m^3	
Coefficient of Drag	C_D = 1.00		
Gravitational Constant	g = 9.81	m/s^2	

Drag Force Equation $$F_D = \frac{1}{2} C_D A p_w v^2$$

Bouyancy Equation $$F_B = Vg(p_w - p_B)$$

Initial Conditions		
t_o =	0	s
v_o =	3.157	mph

ELAPSED TIME (s)	**VELOCITY AT TIME (mph)**	DRAG FORCE (N)	BOUYANCY FORCE (N)	NET FORCE (N)	DISTANCE (m)	**TOTAL DEPTH (ft)**
0	**7.1**				0.0	**0.0**
0.100	2.2	269.8	37.5	-307.3	0.18	0.6
0.200	1.2	75.6	53.4	-129.1	0.25	0.8
0.300	0.6	22.3	62.2	-84.4	0.30	1.0
0.400	0.2	3.3	66.4	-69.7	0.32	1.0
0.470		0.0	67.1	-67.1	0.32	1.1
0.500						
0.600						
0.700						
0.770						
0.800						
0.900						
1.000						
1.010						
1.100						
1.110						
1.170						

Drops Vertically into the Pool

Height of COM	h = 1.33	m	
Mass of Person	m = 50.79	kg =	112 lb
Density of Water	p_w = 1000.00	kg/m^3	
Density of Person	p_B = 980.00	kg/m^3	
Cross-Sectional Area	A = 0.09	m^2 =	1 ft^2
Length of Person	L = 1.64	m =	5.375 ft
Volume of Person	V = 0.33	m^3	
Coefficient of Drag	C_D = 1.00		
Gravitational Constant	g = 9.81	m/s^2	

Drag Force Equation $$F_D = \frac{1}{2} C_D A p_w v^2$$

Bouyancy Equation $$F_B = V g (p_w - p_B)$$

Initial Conditions		
t_o =	0	s
v_o =	3.157	mph

ELAPSED TIME (s)	**VELOCITY AT TIME (mph)**	DRAG FORCE (N)	BOUYANCY FORCE (N)	NET FORCE (N)	DISTANCE (m)	**TOTAL DEPTH (ft)**
0	**7.1**				0.0	**0.0**
0.100	5.4	286.4	10.9	-297.4	0.28	0.9
0.200	4.4	184.1	19.5	-203.6	0.50	1.6
0.300	3.6	125.0	26.5	-151.5	0.68	2.2
0.400	3.0	87.5	32.3	-119.8	0.83	2.7
0.500	2.5	62.1	37.1	-99.3	0.95	3.1
0.530	2.4	56.1	38.4	-94.5	0.99	3.2
0.600	2.1	44.1	41.2	-85.3	1.06	3.5
0.700	1.8	30.9	44.7	-75.6	1.15	3.8
0.800	1.5	21.0	47.6	-68.6	1.22	4.0
0.890	1.2	14.3	49.7	-64.0	1.27	4.2
0.900	1.2	13.7	49.9	-63.6	1.28	4.2
1.000	0.9	8.2	51.8	-60.0	1.33	4.4
1.100	0.7	4.3	53.2	-57.5	1.36	4.5
1.180	0.5	2.2	54.0	-56.1	1.38	4.5
1.200	0.4	1.7	54.1	-55.8	1.39	4.6
1.300	0.2	0.3	54.6	-55.0	1.40	4.6
1.370		0.0	54.7	-54.7	1.40	4.6

Drops Diagonally into the Pool

Height of COM	h = 1.09	m	
Mass of Person	m = 50.79	kg =	112 lb
Density of Water	p_w = 1000.00	kg/m^3	
Density of Person	p_B = 980.00	kg/m^3	
Cross-Sectional Area	A = 0.09	m^2 =	1 ft^2
Length of Person	L = 1.16	m =	3.80069895 ft
Volume of Person	V = 0.33	m^3	
Coefficient of Drag	C_D = 1.00		
Gravitational Constant	g = 9.81	m/s^2	

Drag Force Equation $$F_D = \frac{1}{2} C_D A p_w v^2$$

Bouyancy Equation $$F_B = Vg(p_w - p_B)$$

Initial Conditions		
t_o =	0	s
v_o =	3.157	mph

ELAPSED TIME (s)	**VELOCITY AT TIME (mph)**	DRAG FORCE (N)	BOUYANCY FORCE (N)	NET FORCE (N)	DISTANCE (m)	**TOTAL DEPTH (ft)**
0	**7.1**				0.0	**0.0**
0.100	5.4	285.6	15.4	-301.0	0.28	0.9
0.200	4.3	181.7	27.5	-209.2	0.50	1.6
0.300	3.5	121.2	37.3	-158.5	0.68	2.2
0.400	2.9	82.5	45.3	-127.8	0.82	2.7
0.500	2.4	56.2	51.9	-108.1	0.94	3.1
0.530	2.3	50.0	53.7	-103.6	0.97	3.2
0.600	2.0	37.6	57.4	-95.0	1.04	3.4
0.700	1.6	24.2	61.8	-85.9	1.12	3.7
0.800	1.2	14.5	65.2	-79.7	1.18	3.9
0.890	0.9	8.2	67.6	-75.8	1.23	4.0
0.900	0.9	7.6	67.9	-75.5	1.23	4.0
1.000	0.5	3.1	69.6	-72.8	1.26	4.1
1.100	0.2	0.6	70.6	-71.3	1.28	4.2
1.180		0.0	70.9	-70.9	1.29	4.2
1.200						
1.300						
1.370						

Drops with Tucked Knees into the Pool

Height of COM	$h = 0.92$	m	
Mass of Person	$m = 50.79$	kg =	112 lb
Density of Water	$p_w = 1000.00$	kg/m^3	
Density of Person	$p_B = 980.00$	kg/m^3	
Cross-Sectional Area	$A = 0.25$	m^2 =	2.6875 ft^2
Length of Person	$L = 0.82$	m =	2.6875 ft
Volume of Person	$V = 0.33$	m^3	
Coefficient of Drag	$C_D = 1.00$		
Gravitational Constant	$g = 9.81$	m/s^2	

Drag Force Equation $$F_D = \frac{1}{2} C_D A p_w v^2$$

Bouyancy Equation $$F_B = V g (p_w - p_B)$$

Initial Conditions		
$t_o =$	0	s
$v_o =$	3.157	mph

ELAPSED TIME (s)	**VELOCITY AT TIME (mph)**	DRAG FORCE (N)	BOUYANCY FORCE (N)	NET FORCE (N)	DISTANCE (m)	**TOTAL DEPTH (ft)**
0	**7.1**				0.0	**0.0**
0.100	3.8	403.4	18.5	-421.8	0.24	0.8
0.200	2.6	178.7	29.6	-208.3	0.38	1.2
0.300	1.9	93.5	37.4	-130.9	0.48	1.6
0.400	1.4	51.7	43.2	-94.9	0.55	1.8
0.500	1.0	28.2	47.4	-75.7	0.61	2.0
0.530	0.9	23.3	48.5	-71.8	0.62	2.0
0.600	0.7	14.2	50.5	-64.7	0.65	2.1
0.700	0.5	5.8	52.7	-58.5	0.68	2.2
0.800	0.2	1.4	53.9	-55.2	0.69	2.3
0.890		0.0	54.2	-54.2	0.69	2.3
0.900						
1.000						
1.100						
1.180						
1.200						
1.300						
1.370						

Drops Horizontally into the Pool

Height of COM	h = 0.66	m	
Mass of Person	m = 50.79	kg =	112 lb
Density of Water	p_w = 1000.00	kg/m^3	
Density of Person	p_B = 980.00	kg/m^3	
Cross-Sectional Area	A = 0.50	m^2 =	5.375 ft^2
Length of Person	L = 0.30	m =	1 ft
Volume of Person	V = 0.33	m^3	
Coefficient of Drag	C_D = 1.00		
Gravitational Constant	g = 9.81	m/s^2	

Drag Force Equation $$F_D = \frac{1}{2} C_D A p_w v^2$$

Bouyancy Equation $$F_B = Vg(p_w - p_B)$$

Initial Conditions		
t_o =	0	s
v_o =	3.157	mph

ELAPSED TIME (s)	**VELOCITY AT TIME (mph)**	DRAG FORCE (N)	BOUYANCY FORCE (N)	NET FORCE (N)	DISTANCE (m)	**TOTAL DEPTH (ft)**
0	**7.1**				0.0	**0.0**
0.100	2.5	365.3	40.1	-405.4	0.19	0.6
0.200	1.4	113.8	58.5	-172.3	0.28	0.9
0.300	0.9	40.4	69.3	-109.6	0.33	1.1
0.400	0.4	11.0	75.4	-86.4	0.36	1.2
0.500	0.1	0.6	77.9	-78.5	0.37	1.2
0.530		0.0	78.0	-78.0	0.37	1.2
0.600						
0.700						
0.800						
0.890						
0.900						
1.000						
1.100						
1.180						
1.200						
1.300						
1.370						

Drops Vertically into the Pool

Height of COM	h = 1.38	m	
Mass of Person	m = 66.21	kg =	146 lb
Density of Water	p_w = 1000.00	kg/m^3	
Density of Person	p_B = 980.00	kg/m^3	
Cross-Sectional Area	A = 0.09	m^2 =	1 ft^2
Length of Person	L = 1.74	m =	5.70833333 ft
Volume of Person	V = 0.33	m^3	
Coefficient of Drag	C_D = 1.00		
Gravitational Constant	g = 9.81	m/s^2	

Drag Force Equation $$F_D = \frac{1}{2} C_D A p_w v^2$$

Bouyancy Equation $$F_B = Vg(p_w - p_B)$$

Initial Conditions		
t_o =	0	s
v_o =	3.157	mph

ELAPSED TIME (s)	**VELOCITY AT TIME (mph)**	DRAG FORCE (N)	BOUYANCY FORCE (N)	NET FORCE (N)	DISTANCE (m)	**TOTAL DEPTH (ft)**
0	**7.1**				0.0	**0.0**
0.100	5.7	318.0	10.5	-328.6	0.29	0.9
0.200	4.8	221.9	19.2	-241.1	0.52	1.7
0.300	4.1	160.8	26.6	-187.4	0.72	2.4
0.400	3.5	119.4	32.9	-152.3	0.90	2.9
0.500	3.1	89.8	38.3	-128.2	1.04	3.4
0.600	2.7	68.0	43.1	-111.0	1.17	3.8
0.700	2.3	51.3	47.2	-98.5	1.28	4.2
0.800	2.0	38.4	50.7	-89.1	1.38	4.5
0.900	1.7	28.2	53.8	-82.0	1.47	4.8
1.000	1.4	20.2	56.4	-76.6	1.54	5.0
1.100	1.2	13.9	58.6	-72.5	1.60	5.2
1.200	1.0	9.0	60.4	-69.4	1.65	5.4
1.300	0.7	5.2	61.8	-67.1	1.68	5.5
1.400	0.5	2.6	62.9	-65.4	1.71	5.6
1.500	0.3	0.9	63.5	-64.4	1.73	5.7
1.600	0.1	0.1	63.8	-63.9	1.74	5.7
1.640		0.0	63.9	-63.9	1.74	5.7

Drops Diagonally into the Pool

Height of COM	h = 1.12	m	
Mass of Person	m = 66.21	kg =	146 lb
Density of Water	p_w = 1000.00	kg/m^3	
Density of Person	p_B = 980.00	kg/m^3	
Cross-Sectional Area	A = 0.09	m^2 =	1 ft^2
Length of Person	L = 1.23	m =	4.03640121 ft
Volume of Person	V = 0.33	m^3	
Coefficient of Drag	C_D = 1.00		
Gravitational Constant	g = 9.81	m/s^2	

Drag Force Equation $$F_D = \frac{1}{2} C_D A p_w v^2$$

Bouyancy Equation $$F_B = Vg(p_w - p_B)$$

Initial Conditions		
t_o =	0	s
v_o =	3.157	mph

ELAPSED TIME (s)	**VELOCITY AT TIME (mph)**	DRAG FORCE (N)	BOUYANCY FORCE (N)	NET FORCE (N)	DISTANCE (m)	**TOTAL DEPTH (ft)**
0	**7.1**				0.0	**0.0**
0.100	5.7	317.3	14.9	-332.2	0.29	0.9
0.200	4.8	219.8	27.2	-247.0	0.52	1.7
0.300	4.1	157.4	37.5	-194.9	0.72	2.4
0.400	3.5	114.7	46.3	-160.9	0.89	2.9
0.500	3.0	84.0	53.8	-137.8	1.04	3.4
0.600	2.5	61.3	60.2	-121.5	1.16	3.8
0.700	2.1	44.0	65.6	-109.7	1.26	4.1
0.800	1.8	30.8	70.2	-101.0	1.35	4.4
0.900	1.5	20.6	74.0	-94.6	1.43	4.7
1.000	1.1	12.9	77.1	-90.0	1.48	4.9
1.100	0.9	7.2	79.4	-86.6	1.53	5.0
1.200	0.6	3.2	81.1	-84.3	1.56	5.1
1.300	0.3	0.9	82.1	-83.0	1.58	5.2
1.400	0.0	0.0	82.5	-82.5	1.59	5.2
1.500						
1.600						
1.640						

Drops with Tucked Knees into the Pool

Height of COM	h = 0.94	m	
Mass of Person	m = 66.21	kg =	146 lb
Density of Water	p_w = 1000.00	kg/m^3	
Density of Person	p_B = 980.00	kg/m^3	
Cross-Sectional Area	A = 0.27	m^2 =	2.854167 ft^2
Length of Person	L = 0.87	m =	2.85416667 ft
Volume of Person	V = 0.33	m^3	
Coefficient of Drag	C_D = 1.00		
Gravitational Constant	g = 9.81	m/s^2	

Drag Force Equation $$F_D = \frac{1}{2} C_D A p_w v^2$$

Bouyancy Equation $$F_B = Vg(p_w - p_B)$$

Initial Conditions		
t_o =	0	s
v_o =	3.157	mph

ELAPSED TIME (s)	**VELOCITY AT TIME (mph)**	DRAG FORCE (N)	BOUYANCY FORCE (N)	NET FORCE (N)	DISTANCE (m)	**TOTAL DEPTH (ft)**
0	**7.1**				0.0	**0.0**
0.100	4.2	511.0	18.2	-529.2	0.25	0.8
0.200	3.0	247.9	30.0	-277.8	0.41	1.3
0.300	2.2	139.4	38.5	-177.9	0.52	1.7
0.400	1.7	83.6	45.1	-128.7	0.61	2.0
0.500	1.4	51.0	50.2	-101.2	0.68	2.2
0.600	1.0	30.5	54.2	-84.6	0.74	2.4
0.700	0.8	17.1	57.2	-74.3	0.78	2.6
0.800	0.5	8.4	59.4	-67.8	0.81	2.7
0.900	0.3	3.1	60.8	-63.9	0.83	2.7
1.000	0.1	0.4	61.6	-62.0	0.84	2.8
1.100						
1.200						
1.300						
1.400						
1.500						
1.600						
1.640						

Drops Horizontally into the Pool

Height of COM	h = 0.66	m	
Mass of Person	m = 66.21	kg =	146 lb
Density of Water	p_w = 1000.00	kg/m^3	
Density of Person	p_B = 980.00	kg/m^3	
Cross-Sectional Area	A = 0.53	m^2 =	5.708333 ft^2
Length of Person	L = 0.30	m =	1 ft
Volume of Person	V = 0.33	m^3	
Coefficient of Drag	C_D = 1.00		
Gravitational Constant	g = 9.81	m/s^2	

Drag Force Equation $$F_D = \frac{1}{2} C_D A p_w v^2$$

Bouyancy Equation $$F_B = Vg(p_w - p_B)$$

Initial Conditions		
t_o =	0	s
v_o =	3.157	mph

ELAPSED TIME (s)	**VELOCITY AT TIME (mph)**	DRAG FORCE (N)	BOUYANCY FORCE (N)	NET FORCE (N)	DISTANCE (m)	**TOTAL DEPTH (ft)**
0	**7.1**				0.0	**0.0**
0.100	2.9	506.8	43.1	-549.9	0.21	0.7
0.200	1.7	176.6	64.7	-241.3	0.31	1.0
0.300	1.1	72.8	78.2	-151.0	0.37	1.2
0.400	0.7	27.9	86.8	-114.7	0.41	1.4
0.500	0.3	7.1	91.7	-98.8	0.44	1.4
0.600	0.0	0.1	93.5	-93.6	0.45	1.5
0.700						
0.800						
0.900						
1.000						
1.100						
1.200						
1.300						
1.400						
1.500						
1.600						
1.640						


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NINJA CROSS™
NinjaCross MiniNinja Rules
1. Participants must be a minimum of 48-inches tall
2. Participants maximum weight of 275lbs
3. Wait your turn to start, follow direction by facility staff at all times
4. Diving, jumping, running, pushing, etc. is strictly prohibited
5. Participants to use systems solely at their own risk – this is a skill-based system and is meant to be challenging. Owner, operator, manufacturer and any additional parties will not be held responsible for any injury on the system
6. Climbing obstacles cables, structure column legs or any other components on the system is strictly prohibited
7. Touching obstacle frame or support truss, electronics, or any other components other than the obstacles is strictly prohibited
8. Only use if you are capable of safely swimming the length of the pool and able to hold your breath under-water for 10-seconds or more. Non-Swimmers are not permitted.
9. Only 1 participant per obstacle set at a time, no more than 3 participants on the system at one time
10. Use only under supervision of lifeguard or attendant
11. If you fall into water, move on to next obstacle or swim out of the lane
12. If you feel exhausted or weak, stop participation and swim out of lane to closest pool wall
13. Do not push, shove or harass other guests – bullying will not be tolerated and you may be asked to leave the facility
14. Do not use this equipment while under the influence of alcohol or drugs
15. No diving allowed anywhere around this system
16. Leave MiniNinja pool area promptly after completing the course or if you are unable to complete the course
17. Participants assume all risk of injury due to misuse of the NinjaCross MiniNinja or failure to follow rules
NINJA CROSS

NinjaCross Systems

MiniNinja

Standard Operating Procedures and Operations Manual V1.1

Contact Ninja*Cross* Systems at:

Phone- 800-778-9702

Email- Support@NinjaCrossSystems.com

Section 1

Introduction

The purpose of this operations manual is to provide the owner/operator with the basic rules and maintenance information necessary to operate the NinjaCross MiniNinja System in a manner designed to minimize problems and ensure the safety of the participant(s). This manual deals with the operation of the NinjaCross equipment only. It does not address pool operations, health codes, water quality, or local ordinances.

Facilities should follow the manufacturer's guidelines for installation, safe inspection, maintenance, operations and use of its various fitness systems and features. However, your employer should provide you with a specific set of guidelines and training if you are responsible for these inspections

Most local regulatory agencies have public swimming pool standards. It is recommended that local codes, regulations, and guidelines be followed. This will insure a harmonious relationship between the pool/slide operation and the local authorities.

To assist owners and operators in providing a safe, fun, and enjoyable experience for all facility patrons, NinjaCross Systems provides the following additional services;

- Annual NinjaCross Inspections
- Annual on-site safety training for lifeguards and operators
- Maintenance programs to prolong the life of your investment

Section 2

Terms

Box Truss - a type of truss that uses four major cords with connecting cords to form a strong structure that takes the shape of a rectangular box.

Corner Block - a 12" square aluminum block that mounts to the Aluminum Box truss section. All Static Lines attach at a Corner Block and all cross members of the Obstacle Frame attached at Corner Blocks.

Designated Safety Area - the area that includes all pool space under the obstacle frame and the adjacent 8-feet on either side of the Obstacle Frame stretching from end of pool to opposite end.

Eye Clamp - A clamp that allows attachment of a NetForm Rope or other item to the Obstacle Frame.

Mounting Plate - the square aluminum plate that secures the Obstacle Frame to the pool deck. The plate is anchored by wedge anchors.

NetForm Rope - the rope that connects an obstacle to the Obstacle Frame

Obstacle - a combination of aluminum parts, ropes, and hardware that create a means for the participant to traverse.

OAB (Obstacle Attachment Bar) - An aluminum bat that attached to the Obstacle Frame and allows Obstacles with dual ropes to be attached.

Obstacle Frame - the aluminum truss that Obstacles hang from, Static Cables and Lifting Cables attach to, and BackUp System attaches to.

Obstacle Frame Leg - the aluminum truss vertical sections that hold the Obstacle Frame at elevation. These legs are mounted to the pool deck via the Mounting Plates.

Participant - the guest that is using the NinjaCross MiniNinja system

Pinch Block - an aluminum block with indents that allows it to secure into the tube of the Obstacle Frame. Used for connecting Obstacles to the Obstacle Frame.

Safety Padding - a section of padding applied to deck and pool wall that protects participant from falls against the pool deck.

Swivel Clamp - A dual clamp system that allows attachment of the OAB to the Obstacle Frame.

Section 1

NinjaCross MiniNinja Standard Rules

1. Follow the directions of facility personnel at all times

2. Wait your turn prior to starting

3. Diving, jumping, running, pushing, etc. is strictly prohibited

4. Participants to use system solely at their own risk - this is a skill-based system and is meant to be challenging

5. Climbing obstacle cables, legs, or any other components on their system is strictly prohibited

6. Touching obstacle frame or support truss, electronics, or any other components other than the obstacles is strictly prohibited

7. Do climb the ropes or onto the Obstacle Frame. Do not try to hold onto the Obstacle Frame

8. Only use if you are capable of swimming and able to hold your breath under water for 10-seconds or more

9. Only one participant per obstacle set at a time. A maximum or 2 participants may be on a single lane at any one time. The minimum distance between participants shall be no less than 10'

10. Use only under the supervision of lifeguard or attendant

11. Swinging, leaping, jumping, or swimming in adjacent lane is strictly prohibited

12. No standing on Above Water Level obstacles

13. If you fall on an obstacle, move onto the next obstacle and attempt to complete

14. If you feel exhausted or weak, stop participation and swim out of lane to closet pool wall

15. Do not push, shove, or harass other guests - bullying will not be tolerated, and you will be asked to leave facility.

16. Recommended Minimum age 5 years old

17. Minimum Height 48" tall

18. Maximum Weight 270lbs

19. Participant must not wear lifejacket, shoes (including swim shoes), loose jewelry, or other item of clothing that may get caught in obstacles

20. Lifeguards are responsible for final determination of swim ability, age, and height according to the existing rules of the facility.

21. Intoxicated person are not allowed to use the system or operate the system

22. No spectators in the designated safety area of the pool

Section 2

End of Day Procedures

End of Day Washdown

•This procedure should be followed on a daily basis

• Rinse the Obstacle Frame including the Ropes, Plates, and other attachments with fresh water

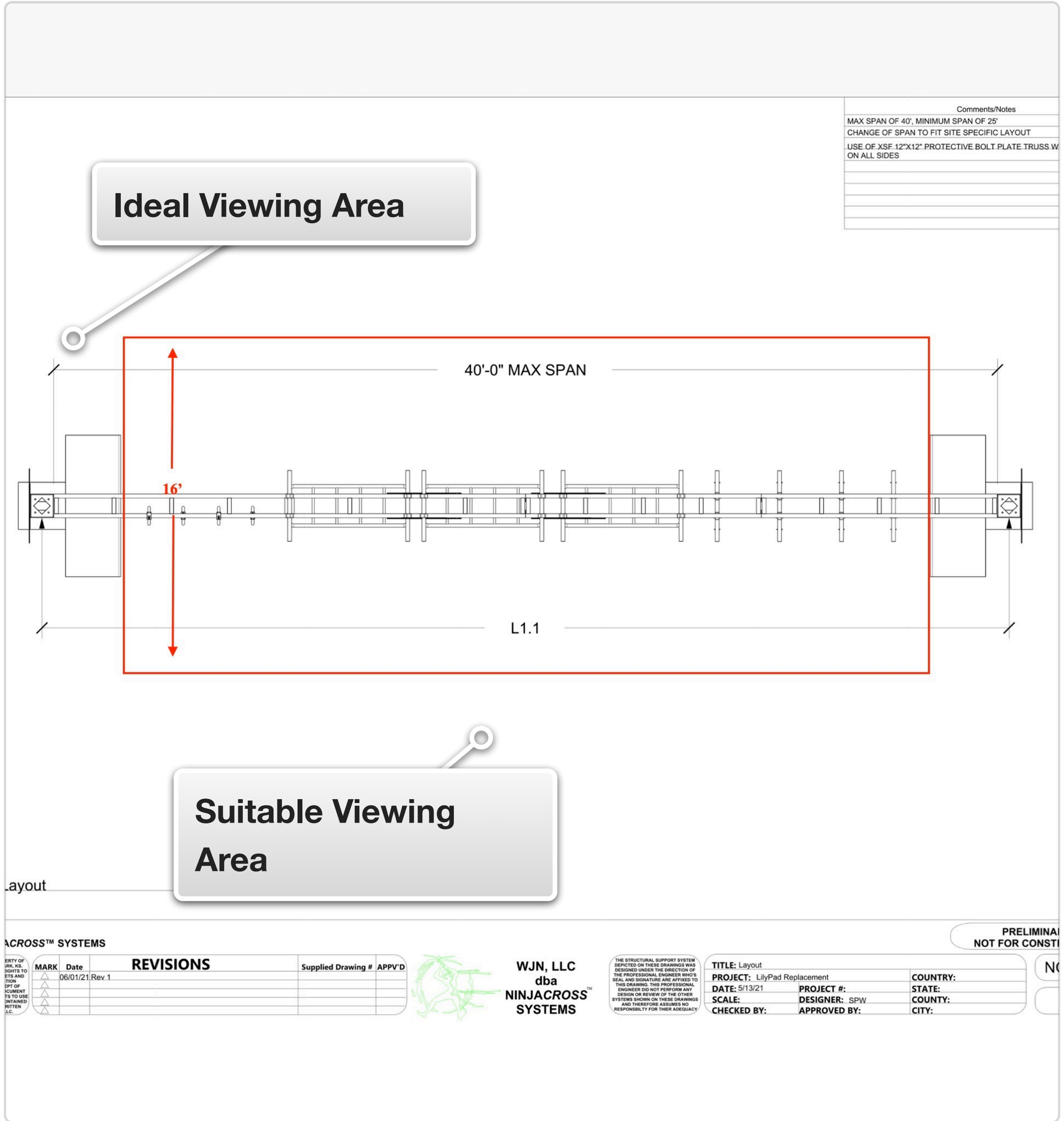
Designated Safety Area

he Designated Safety Area is the zone where only participants may be in the pool during the operating time of the NinjaCross MiniNinja System. The safety area is detailed as the area directly under the Obstacle Frame as well as an additional 8-feet on either side of the Obstacle Frame stretching from end of pool to end of pool.

During operations, spectators are prohibited from entering the Designated Safety Area.

Participants who quit the course without finishing shall be instructed to exit the course to the outside of the Designated Safety Area without crossing the path of other participants and exit the Designated Safety Area as quickly and safely as possible.

Interactive 3.1 Designated Safety Area



1 2

Section 4

Seasonal Shut Down Procedures

Long Term Shutdown

Procedures

When storing the Ninja*Cross* MiniNinja system for winter or long-term storage, the following steps should be taken.

1. Remove all obstacles and store in a secure safe location. Take care in storing obstacles as to not damage the materials or coating.

2. Store Ropes in a dry location free of any chemicals.

Section 1

Obstacle Types

There are two types of obstacles with the NinjaCross MiniNinja System a) OAB mounted obstacles, and b) Direct frame mounted obstacles.

OAB mounted obstacles are those obstacles that use 2 or more cables attached to the obstacle and require a spacing of more than 12” between the NetForm ropes. The OAB attaches to the Obstacle Frame by way of 2 Swivel Clamps. Obstacles attach to the OAB via the stud connection on the OAB and the shackles of the NetForm Rope.

Examples of OAB Mounted Obstacles are:

Trapeze Bars   Low Bars   Ladders

Direct frame mounted obstacles are those obstacles that attach to the Obstacle Frame directly by use of an Eye Clamp or other method.

Examples of Direct Mounted Obstacles are:

Sea of Discs   Overhead Rings   CannonBall Alley

Section 2

Obstacle Mounting Procedures

In order to mount any obstacle using a Swivel Clamp or Eye Clamp the following procedures need to be followed

1. Ensure that the Obstacle Frame is fully deployed in its operational position and the pool is clear of all swimmers.

2. Choose location for obstacle to be mounted.

3. Choose correct type of clamp for the obstacle to be installed

4. Unscrew the wing nut on the clamp to allow clamp to easily open

5. Place clamp in position, close the clamp over the Obstacle Frame tube, close bolt into clamp tab ensuring that the wing nut and washer clear the top of the clamp.

6. Tighten the wing nut until snug, do not over tighten as damage may occur to the Obstacle Frame truss

7. Attach obstacle to Eye Clamp or attach OAB to Swivel Clamps.

   a. If using an Eye Clamp, open the shackle at end of the NetForm Rope by turning the shackle pin counterclockwise using an Allen wrench. Place shackle over the open eye of the clamp and insert shackle pin into the shackle through the eye of the clamp. Tighten shackle pin (the use of blue Loctite will ensure shackle does not come loose.)

   b. If using an OAB, open the shackle at end of the NetForm Rope by turning the shackle pin counter-clockwise using an Allen wrench. Place shackle over the open stud of the OAB and insert shackle pin into the shackle through the stud of the OAB. Tighten shackle pin (the use of blue Loctite will ensure shackle does not come loose.)

When moving Obstacles from initial installed location, please refer to the Obstacle Water Depth Chart included in this manual to ensure obstacles are installed over the proper depth of pool.

Access to truss can be by use of a secured ladder in the pool leaned up against the Obstacle Frame or by use of the EZ Dock floating dock system. Care must be taken to not put excessive lateral force on the Obstacle Frame at any time, and at no time should staff sit, stand, or walk on the Obstacle Frame for access.

Obstacle Water Depth

Obstacle	Min Water Depth in Feet
Overhead Rings	4
Rising Rings	4
Cannonball Alley	5
Low Bar	4
Trapeze Bar	4
Ladder	4
Camelback	5

Section 3

Obstacle Frame

The Obstacle Frame is a 12”x12” aluminum box truss connected by way of Corner Blocks. The Obstacle Frame is the connection point for all Obstacles. The Obstacle Frame is designed to distribute the weight of the Obstacles and participants over a specified range according to the individual design of each system.

The Obstacle Frame is bolted together with 5/8”x2.5” Stainless Steel or Galvanized Bolts. The bolts utilize 5/8” washers and 5/8” nylon washers. The Nylon Washers prevent galvanic reactions from occurring on the different metal types of the bolts and Obstacle Frame.

12”x12” 6-way Corner Blocks are installed every at the vertical legs. All cross members of the Obstacle Frame are connected at Corner Blocks. Corner Blocks utilize the same 5/8” hardware as other parts of the Obstacle Frame.

Section 1

Obstacle Frame Maintenance

Cleaning

Powder coated aluminum should require little maintenance, other than to gently clean with water and a mild liquid detergent to remove any dirt or splashes. A microfiber cloth or sponge should be used to wipe over the surfaces of the furniture. Removing surface water with a drying cloth (like you would use on your car) will help avoid water spots. Avoid using any abrasive cleaning agents or materials, as these could mark the surface of the powder coat. Do not use steel wool or Scotch-Brite on powder coated surfaces.

Section 2

Obstacle Maintenance

Aluminum Obstacles

Cleaning

Powder coated aluminum should require little maintenance, other than to gently clean with water and a mild liquid detergent to remove any dirt or splashes. A microfiber cloth or sponge should be used to wipe over the surfaces of the furniture. Removing surface water with a drying cloth (like you would use on your car) will help avoid water spots. Avoid using any abrasive cleaning agents or materials, as these could mark the surface *of the powder coat. Do not use steel wool or Scotch-Brite on powder coated surfaces.*

Paint and Coatings Care

Over the course of use, the obstacles will receive chips and scraps on the coated surfaces. It is important that these chips and scraps be attended to as soon as they are discovered to prevent them from worsening. When a chip or scrap is discovered it is important to follow these procedures.

1. Remove obstacle from the water
2. Completely dry the obstacle and wipe clean any dirt or residues
3. Apply touch up paint to effected area
4. Allow paint to completely dry before allowing obstacle to get wet

Ropes

Cleaning

Rinse with clean fresh water, do not use chemicals or abrasives.

Section 3

Material Specific Maintenance

The following pages have information on the proper methods for cleaning specific types of metals found in the Ninja*Cross* MiniNinja System. If you have any questions, please contact Ninja*Cross* Systems for advise.

Care and Cleaning of Stainless Steel

Introduction

Cleanliness and stainless steel are closely related and, in many applications, each is dependent upon the other. In the handling of food, chemicals, pharmaceuticals and in the use of stainless steel as a construction material (roofs, wall panels, entry ways, signs, etc.), stainless steel provides the degree of corrosion resistance that is necessary to prevent product contamination or surface rusting. However, stainless steel performs best when clean — cleanliness is essential for maximum resistance to corrosion.

This handbook describes various practices for cleaning stainless steel during manufacture and in use. This includes methods for removing free-iron contamination on stainless steel surfaces that may have been picked up from metalworking tools; and for removing general accumulation of dirt, grime and surface stains that occur during normal handling and exposure to the elements.

The reader should keep in mind that there are few specific rules for a cleaning procedure. Accordingly, the methods discussed in this handbook are suggestions. Each manufacturer or user, after obtaining competent advice with respect to their individual requirements, should select methods appropriate to those requirements.

What is Stainless Steel?

Stainless steel is not a single alloy, but rather the name applies to a group of iron-based alloys containing a minimum 10.5% chromium. Other elements are added and the chromium content increased to improve the corrosion resistance and heat resisting properties, enhance mechanical properties, and/or improve fabricating characteristics. There are over 50 stainless steel grades that were originally recognized by the American Iron and Steel Institute (AISI). Three general classifications are used to identify stainless steel. They are:

1) Metallurgical structure.

2) The AISI numbering system (200, 300 and 400 series numbers).

3) The Unified Numbering System, which was developed by the American Society for Testing Materials (ASTM) and the Society of Automotive Engineers (SAE) to apply to all commercial metals and alloys.

The various types of stainless steel are detailed in a designer handbook, “Design Guidelines for the Selection and Use of Stainless Steel,” available from the Specialty Steel Industry of North America (SSINA). Several other publications are also available, including: “Stainless Steel Fabrication,” “Stainless Steel Fasteners,” “Stainless Steel Finishes,” “Stainless Steel Specifications,” and “Stainless Steel Architectural Facts,” to mention a few.

Alloy Types

304 is the basic chromium-nickel austenitic stainless steel and has been found suitable for a wide range of applications. It is the most readily available in a variety of product forms. This grade is easy to form and fabricate with excellent resistance to corrosion.

•304L is the low carbon version of 304. It is sometimes specified where extensive welding will be done.

•316 offers a more corrosion-resistance through the addition of molybdenum. This grade is desirable where the possibility of severe corrosion exists, such as heavy industrial atmospheres and marine environments.

•316L is the low carbon version of 316.

•430 is a straight chromium ferritic stainless steel with lower corrosion resistance than the 300 series. It is principally employed for interior use.

Cleaning of Stainless Steel

Stainless steels need to be cleaned for aesthetic considerations and to preserve corrosion resistance. Stainless steel is protected from corrosion by a thin layer of chromium oxide. Oxygen from the atmosphere combines with the chromium in the stainless steel to form this passive chromium oxide film that protects from further corrosion. Any contamination of the surface by dirt, or other material, hinders this passivation process and traps corrosive agents, reducing corrosion protection. Thus, some form of routine cleaning is necessary to preserve the appearance and integrity of the surface. Stainless steels are easily cleaned by many different methods. They actually thrive with frequent cleaning, and unlike some other materials, it is impossible to “wear out” stainless steel by excessive cleaning. The effect of surface/pattern roughness, grain/pattern orientation and designs that allow for maximum rain cleaning (exterior applications)should be considered.

Types of surface contaminants

• Dirt -Like any surface that is exposed to the environment, stainless steel can get dirty. Dirt and soil can consist of accumulated dust and a variety of contaminates that come from many sources, ranging from the wind to everyday use. These contaminates will vary greatly in their effect on appearance and corrosively and ease of removal. While some may be easily removed, others may require specific cleaners for effective removal. It may be necessary to identify the contaminate or experiment with various cleaners. Frequently, warm water with or without a gentle detergent is sufficient.

Next in order are mild non-scratching abrasive powders such as typical household cleaners. These can be used with warm water, bristle brushes, sponges, or clean cloths. Ordinary carbon steel brushes or steel wool should be avoided as they may leave particles embedded on the surface which can lead to RUSTING. For more aggressive cleaning, a small amount of vinegar can be added to the scouring powder. Cleaning should always be followed by rinsing in clean hot water. When water contains mineral solids, which leave water spots, it is advisable to wipe the surface completely with dry towels.

• Fingerprints and Stains -Fingerprints and mild stains resulting from normal use in consumer and architectural applications are the most common surface contaminates. Fortunately, these usually affect only appearance and seldom have an effect on corrosion resistance. They are easy to remove by a variety of simple cleaning methods. Fingerprints are probably the most troublesome marks to remove from the surface of smooth polished or bright finished stainless steel. Fortunately, they can be removed with a glass cleaner or by gentle rubbing with a paste of soda ash (sodium carbonate) and water applied with a soft rag. Once again, this should be followed by a thorough warm water rinse. There are several special surface finishes where fingerprints present special problems: polished No. 6, etched, some abrasive blasted finishes, and light electrochemical colors applied over satin or brushed finishes.

(NOTE: there are several special finishes designed to withstand fingerprints: embossed, swirl patterns, lined patterns, etc.).

• Shop oil and Grease -Shop oils, which may carry grease, grit and metal chips, commonly produce surface soiling after many shop operations. Greases and other contaminates may also soil surfaces in food preparation and many other household and commercial situations. These soils may be corrosive in themselves or may not allow the surface to maintain passivity, and so periodic removal is a necessity. Initially, soap or detergent and water may be tried or a combination of detergent and water plus a solvent. The removal of oil and grease from stainless steel parts by immersion in chemical solvents is frequently used with cold-formed or machined parts that are laden with lubricants. This process, in its simplest form, consists of bringing liquid solvent into contact with the surface to be cleaned and allowing dissolution to take place; for example, washing a surface with trichloroethylene or similar liquid or stirring a batch of small parts in a container of solvent. Non-halogenated solvents, such as acetone, methyl alcohol, ethyl alcohol, methyl ethyl ketone, benzene, isopropyl alcohol, toluene, mineral spirits, and turpentine work well.

Many of these solvents are widely used as individual cleaners, but there are thousands of blended or compound cleaners on the market. Users are advised to contact suppliers of solvents for information on their applications on stainless steel.

Types of Cleaners and Methods

General Precautions

In selecting cleaning practices, consider the possibility of scratching and the potential for post-cleaning corrosion caused by incompletely removed cleaners. Scratching can occur on a bright mirror finish by cleaners that contain hard abrasives, or even by “grit” in wash water. This is usually not a problem on dull finishes, or those surfaces finished with a coarse polishing grit. The best preventative measure is to avoid using abrasive cleaners unless absolutely necessary. When abrasives are needed, first experiment on an inconspicuous area. A “soft abrasive,” such as pumice, should be used. Abrasives can permanently damage some colored and highly polished finishes. Advice should be obtained from the finish supplier when cleaning special finishes. Many cleaners contain corrosive ingredients which require thorough post-clean rinsing with clean water; however, thorough rinsing is recommended for all cleaning procedures.

• **Clean Water and Wipe** - The simplest, safest, and least costly method that will adequately do the job is always the best method. Stainless surfaces thrive with frequent cleaning because there is no surface coating to wear off stainless steels. A soft cloth and clean warm water should always be the first choice for mild stains and loose dirt and soils. A final rinse with clean water and a dry wipe will complete the process and eliminate the possibility of water stains.

• **Solvent Cleaning** -Organic solvents can be used to remove fresh fingerprints and oils and greases that have not had time to oxidize or decompose. The preferred solvent is one that does not contain chlorine, such as acetone, methyl alcohol, and mineral spirits. There are many compounded or blended organic cleaners that are commercially available and attempt to optimize both clean ability and safety attributes. Cleaning can be accomplished by immersing smaller articles directly into the solvent, wiping with solvent-impregnated cloths, or by sophisticated vapor or spray methods. The wiping technique sometimes leaves a streaked surface.

Effective Cleaning Methods

• **Household Cleaners -** Household cleaners fall into two categories: detergent (non-abrasive) and abrasive cleaners. Both are effective for many mild dirt, stain, and soil deposits, as well as light oils such as fingerprints. The abrasive cleaners are more effective but introduce the possibility of scratching the surface. However, the degree of abrasiveness will vary greatly with the particular product, and some brands will produce noticeable scratching on only the most highly polished and some colored surfaces. All of these cleaners vary widely with respect to their acidity and the amount of chloride they contain. A neutral cleaner low in chloride is preferred unless the user is assured that the surface can be thoroughly rinsed after cleaning. The fact that the label states “for stainless steel” is no guarantee that the product is not abrasive, not acidic, or low in chloride. The cleaning method generally employed with these cleaners is to apply them to the stainless surface and follow by cloth wiping, or to wipe directly with a cleaner-impregnated soft cloth. In all cases, the cleaned surface should be thoroughly rinsed with clean water and wiped dry with a soft cloth if water streaking is a consideration.

• **Commercial Cleaners -** Many commercial cleaners compounded from phosphates, synthetic detergents, and alkalis are available for the cleaning of severely soiled or stained stainless surfaces. When used with a variety of cleaning methods, these cleaners can safely provide effective cleaning. Manufacturers should be consulted and their recommendations followed whenever using cleaners of this kind. The general precautions stated above also pertain to these cleaners.

Care of Stainless Steel

The cleaner stainless steel can be kept while in storage, being processed or during use, the greater the assurance of optimum corrosion resistance. Some tips on the care of stainless steel are listed below:

1) Use paper or other protective wrapping on the surface of the stainless steel until processing is complete.*

2) Handle stainless steel with clean gloves or cloths to guard against stains or finger marks.

3) Avoid the use of oily rags or greasy cloths when wiping the surface.

4) Do routine cleaning of exposed surfaces. Buildings with window washing systems can utilize this method to clean exterior panels.

5) Where possible, after cleaning, rinse thoroughly with water.

6) Cleaning with chloride-containing detergents must be avoided.

7) Even the finest cleaning powders can scratch or burnish a mill-rolled finish. On polished finishes, rubbing or wiping should be done in the direction of the polish lines, NOT across them.

8) **DO NOT USE SOLVENTS** in closed spaces or while smoking.

*Many adhesive-backed papers and plastic sheets or tape applied to stainless steel for protection "age" in fairly short periods of time and become extremely difficult to remove.

Manufacturers should be contacted regarding information as to how long protective films or paper can be left in place.

Acknowledgments

The Specialty Steel Industry of North America (SSINA) acknowledges that this new handbook contains information originally published by the Committee of Stainless Steel Producers, American Iron and Steel Institute, which no longer exists. Current SSINA member companies were represented on that committee. The SSINA wishes to acknowledge the contributions of the Nickel Development Institute and its consultant, Technical Marketing Resources (Pittsburgh, PA) for help in preparing the contents of this handbook.

The Specialty Steel Industry of the North America (SSINA) and the individual companies it represents have made every effort to ensure that the information presented in this handbook is technically correct. However, neither the SSINA nor its member companies warrants the accuracy of the information contained in this handbook or its suitability for any general and specific use. The SSINA assumes no liability or responsibility of any kind in connection with the use of this information. The reader is advised that the material contained herein should not be used or relied on for any specific or general applications without first securing competent advice.

Powder Coating Care and Maintenance

Proper Care of Powdered Surfaces Is Essential

Powder coatings that are applied to metal products exposed to the weather will inevitably degrade over time. A number of conditions, including those found in nature, will contribute to shortening the life of this type of protective finish.

•Sun

•Rain

•Wind

•Pollution

•Cold weather

•Salt water

•Electrical current

•Dissimilar metals

How to Maintain Powder Coated Surfaces

1. Avoid harsh chemicals: Unlike spray paint, powder coating is much more resistant to things like rust, corrosion, peeling and fading. However, that resistance does not mean it's completely fine to use chemical cleaners and solvents to clean powder coated items. Harsh cleaners and solvents like acetone can actually damage powder coating.

2. Clean gently: You can still clean powder coated surfaces. Just wipe off dust with a soft clock. If more cleaning is necessary, use a highly diluted, mild soap in water and a soft towel or soft sponge to very gently clean. Rinse with a little water, then dry with another soft towel.

3. Wax: If your powder coated metal has lost its gloss and shine, after removing dirt with mild soap, you can apply a thin layer of wax just like you do after you wash your car. After the wax dries, wipe all of it off and powder coated metal will look like new.

4. Don't paint: If you're wondering if you can touch up imperfections and rust with paint, the answer is no. Because of how the powder coating process works, paint won't adhere to powder coated surfaces. If your powder coating is starting to show signs of wear and tear, it's time to have a professional either repair or redo the powder coating.

5. Maintenance schedules: We recommend you regularly inspect and clean your powder coated items. How often you wipe your metal surfaces clean depends on the amount of dirt and grime in the area, the time of year, and if there's been any intense weather like a hurricanes or tornados.

NetForm Ropes

System Inspection

NetForm structures and associated hardware including backing nets, cables and fasteners should be inspected by a competent person after installation and on a regular scheduled basis thereafter. It is good practice to keep a dated and signed maintenance log of each netting system to assure that all safety measures have been followed.

The system must be inspected following alterations, repairs and impact loading. If any welding or cutting operations occur near the structures, weld protection must be provided for that area, and more frequent inspections should be conducted in proportion to the dangers involved.

NetForm should be inspected on a daily and weekly basis.

• Daily Inspection should include a quick visual of the NetForm and any backing netting, to look for any obvious broken net mesh or frays. Report for replacement any missing NetForm cross joints or tees.

• Weekly Inspection should include any lashing cord that may be used in the NetForm system, including loose and broken lashes. Repair as necessary. Visually check and hand-test all rope handrails, hardware, cables, anchors, etc. All hardware should be in place with no substitutes. Document any faults with a photograph to help expedite repairs.

General Environmental Inspection

NetForm, backing nets or hardware that show deterioration from mildew, corrosion, wear, or stress, that may affect their strength, must be immediately removed from service for further inspection, repair or disposal.

• Inspect the NetForm and backing nets for cuts, pulls, fraying of material and discoloration indicating material aging.

• Inspect cross joints and tees for stress cracking.

• Inspect support cables for cuts, twists, kinks, fraying of strands and corrosive rust.

• Inspect support and anchor hardware to assure fasteners are properly secured and that no pieces are missing. Look for damaging rust that may affect hardware strength or abrade the NetForm or backing nets.

Repairs

Field repairs and modifications may be done with guidance and materials from the manufacturer. Photographs are always the best way to convey the extent of a fault area. If replacement of a net panel or system is required, the manufacturer will determine the best method of replacement.

ABS Wrap/Signage Care

• Clean debris from wraps and signage as they appear dirty. Failure to remove debris may make care more difficult over time.

• Test any cleaning solutions on a small section of wrap before using to clean wrap.

• Use a wet, non-abrasive detergent and a soft clean rag for cleaning.

• Rinse thoroughly with clean water. Dry with a microfiber cloth.

• If choosing to wax the wrap, use only waxes that do not contain petroleum distillates

• Do not use mechanical brushes or pressure washers to clean the wraps. Doing so may damage the graphics or wraps themselves.

Vertical Truss Leg Wraps are not included in base MiniNinja System. NinjaCross Systems suggests the use of wraps to prevent access to the Obstacle Frame.

Section 1

Daily Pre-use Inspections

Prior to use each day, the system must undergo a complete Pre-use Daily Inspection to ensure that the system components are in proper working order and ready for use. This is a comprehensive inspection that is done at start of each day.

The complete system SHALL undergo the following inspections as laid out and documented. Any problems, concerns, or points of interests SHALL be noted in the inspection logs for review by NinjaCross Systems.

1. Ensure that the Obstacle Frame Legs are secured to the mounting plates.

2. Ensure Obstacle Frame is secure and not damaged.

3. Ensure that all Obstacles are in proper placement and not entangled in the Obstacle Frame, OAB's, or Signage.

4. Check the pool and surrounding deck for parts, hardware, or materials that may have fallen.

5. Ensure all Obstacles are at their proper depth in the pool and are located as designed.

6. Inspect NetForm Ropes for damage, broken strands, or opening or fraying. Check for mildew or staining.

7. Have lifeguards run through both lanes to ensure system is operating correctly.

8. Ensure that all signage is undamaged, visible without obstructions, and can be viewed by participants on the deck.

9. Document inspection and note any concerns or problems.

Section 2

Quarterly Inspection

The complete system **SHALL** undergo the following quarterly inspections as laid out and documented. Any problems, concerns, or points of interests **SHALL** be noted in the inspection logs for review by NinjaCross Systems.

1. Obstacle Frame -

a. Check that Obstacle Frame joints, where two Truss Sections meet or a Truss Section and Corner Block meet, are secure and not loose.

b. Ensure that all hardware is present at every joint, each Truss Section is bolted to a Truss Section or Corner Block with 4 bolt assemblies.

c. Check for chipped paint

d. Checked for cracked paint, cracked paint may indicate a stress fracture in the truss cord.

e. Ensure that the Obstacle Frame is level both side to side and front to back

f. Rinse frame with fresh water

2. Obstacles -

a. Ensure that there are no broken welds

b. Ensure cables are not frayed, dog-legged, or damaged.

c. Ensure all connection of obstacles are secure and not loose

d. Repair any damage to painted surfaces.

Section 3

Yearly Inspection

All NinjaCross MiniNinja System components **SHALL** be inspected annually by NinjaCross Systems or an authorized representative. Failure to have the system inspected will result in NinjaCross Systems notifying all relevant inspection authorities that the system cannot be declared safe to use by manufacturer.

A minimum of 4-weeks' notice to NinjaCross Systems must be given for scheduling the annual inspection. Contact NinjaCross Systems via your sales contact or directly at Support@NinjaCrossSystems.com

Annual Inspection **SHALL** include and inspection of the following items to ensure the safe and proper working order of the NinjaCross MiniNinja System.

1. Obstacle Frame System including mounting plate
2. Obstacles
3. Inspection and Maintenance Logs

Section 4

Inspection Forms

Ninja*Cross* Systems has provided the following sample inspection forms for use or as a guideline to creating your own inspection forms. At minimum, all inspection forms must include the items including in each form.

Inspection Forms

Ninja*Cross* : Daily Pre-use Inspection

Description : Daily safety checks to be performed prior to use.

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	Monthly
Obstacle Frame Mounting Plate																																
Obstacle Frame																																
Obstacle Ropes																																
Obstacles																																

Notes :

Inspection Forms

Ninja*Cross* : Quarterly Inspection

Description : System inspection every 3 months

	1st Quarter	2nd Quarter	3rd Quarter	4th Quarter
Obstacle Mounting Plate and Anchors				
Obstacle Frame Connections				
Obstacle Connections				
Obstacle Rope integrity				
Obstacle integrity				

Notes :

Certification and Training

Detailed instructions, extensive training, and actual operations specific to each NinjaCross MiniNinja System will be provided and addressed during the on-site Training and Certification conducted by The Owner/Operator of the MiniNinja System. The Owner/Operator will be responsible for instructing the operations team on Operations, Daily, Quarterly, Seasonal and Annual Inspections, Safe Usage, Procedures to follow in order to minimize possible injuries as well as cleaning and maintenance to

insure the longevity of your obstacle course & fitness system.

Section 1

Personnel Training

(Please Note the Following Contains the Manufactures Minimum Recommendations but are Subject to Your Facilities Local and State Codes as well as contracted Third Party Organizations such as the American Red Cross)

Having properly trained and conscientious employees on site is the most important safety factor in the operation of the NinjaCross MiniNinja System.

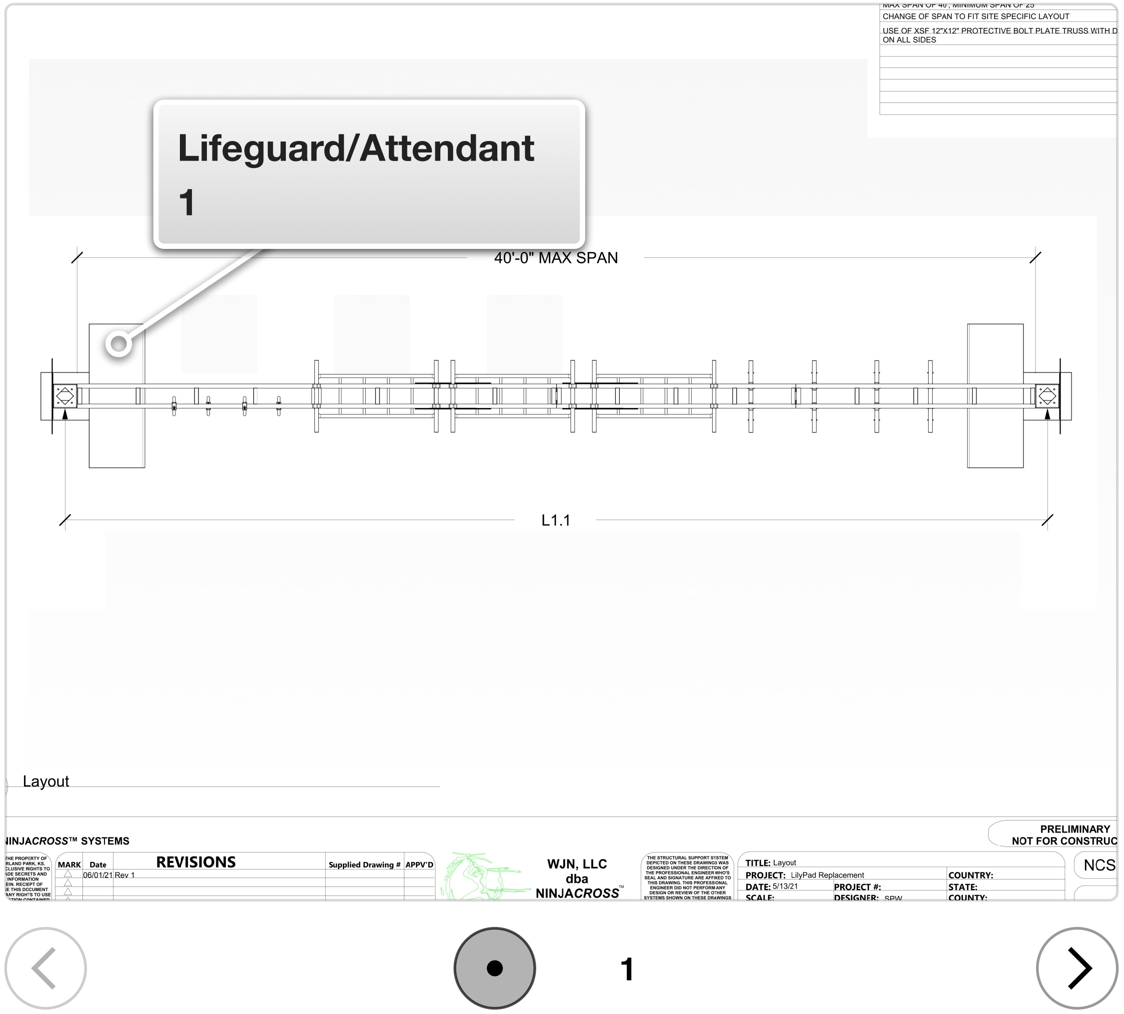
It is our recommendation that all employees who are responsible for the NinjaCross MiniNinja System operations be certified lifeguards and be qualified in both first-aid and life-saving techniques through the American Red Cross training or the equivalent. At least one person who has completed the Standard First Aid and Personal Safety course, as offered by the American Red Cross, or the equivalent should be on duty always during operating hours. This person should also be competent in carrying out any emergency procedures peculiar to the slide he or she is operating. Under most conditions, this is also a recommendation of the insurance carrier if applicable.

Each owner/operator shall have written operating procedures for the NinjaCross MiniNinja System, which are an integral part of their staff-training program. These procedures shall include but not be limited to:

Lifeguard/Attendant Station 1 - one trained lifeguard/attendant SHALL be stationed at the edge of the pool at the starting location. This staff duties are to ensure that all Participants start in the water, to ensure the proper spacing of Participants at the start, and to observe Participants at the start of the course.

All NinjaCross MiniNinja personnel should be alert to controlling crowd behavior and the proper entry rate into the pool; therefore, we recommend the line to participate be formed on the pool deck rather than the pool edge. One Participant may be stationed at the edge of pool to start the course, while any additional may be at a point away from the pool edge preparing to move into starting position at the command of the lifeguard/attendant. Once the Participant who is at edge of pool starts the course the Participant

Interactive 7.1 Lifeguard/Attendant locations



on the deck enters the starting area at the edge of the pool then the line then moves up one position.

Lifeguards at the start of the course should address each and every Participant when it is their turn and then inform the Participant on the rules of the course prior to starting the course. All Participants should be instructed how to use the course and not allowed to run, jump, or leap into the pool. The Lifeguard(s) stationed at start will address each Participant first by asking that they follow their instructions and Do Not proceed into the pool until they are given the okay to do so.

Safe and orderly exit from the pool area helps reduce the risk of disoriented riders colliding with other pool guests. Lifeguards shall instruct Participants to exit the Designated Safety Area in the correct manner and direction.

An uninterrupted view of the pool and Obstacle Frame must be maintained at all times. It is recommended that all lifeguards be familiar with all the jobs related to the Obstacle Frame. Rotating lifeguards between positions keeps interest and attention high.

Facility Requirements

Communications

Each facility shall ensure they have a communication plan in place for all staff working the NinjaCross MiniNinja System and have trained them in the proper use of signals, devices, or other methods.

Signage:

The owner/operator shall place signage as specified. These signs shall include safety, warning, and instructional signage reflecting manufacturer recommendations. Signage shall be prominently displayed at the course entrance or other appropriate area and shall include but not be limited to:

•**Instructions, which include:**

•Expected participant conduct,

•Dispatch procedures,

•Exiting procedures, and

•Obey attendant/lifeguard instructions.

•**Warnings, which include:**

•NinjaCross MiniNinja characteristics, such as challenging & competitive

•Water depth if not posted near pool edge already

•**Requirements which include:**

•Participants being free of medical conditions, including but not limited to pregnancy and heart, back, or musculoskeletal problems,

•Mental conditions that may prevent comprehension or adherence to posted rules,

•Maximum/minimum height and weight, and

•Any swimming or physical ability requirement or both.

Section 1

System Overview

Your Ninja*Cross* MiniNinja System is an indoor or outdoor system that includes the deck mounted anchor points and mounts. This section will give an overview of the different materials that make up the components of the system.

Stainless Steel Components

1. Bolting Hardware
2. Shackles

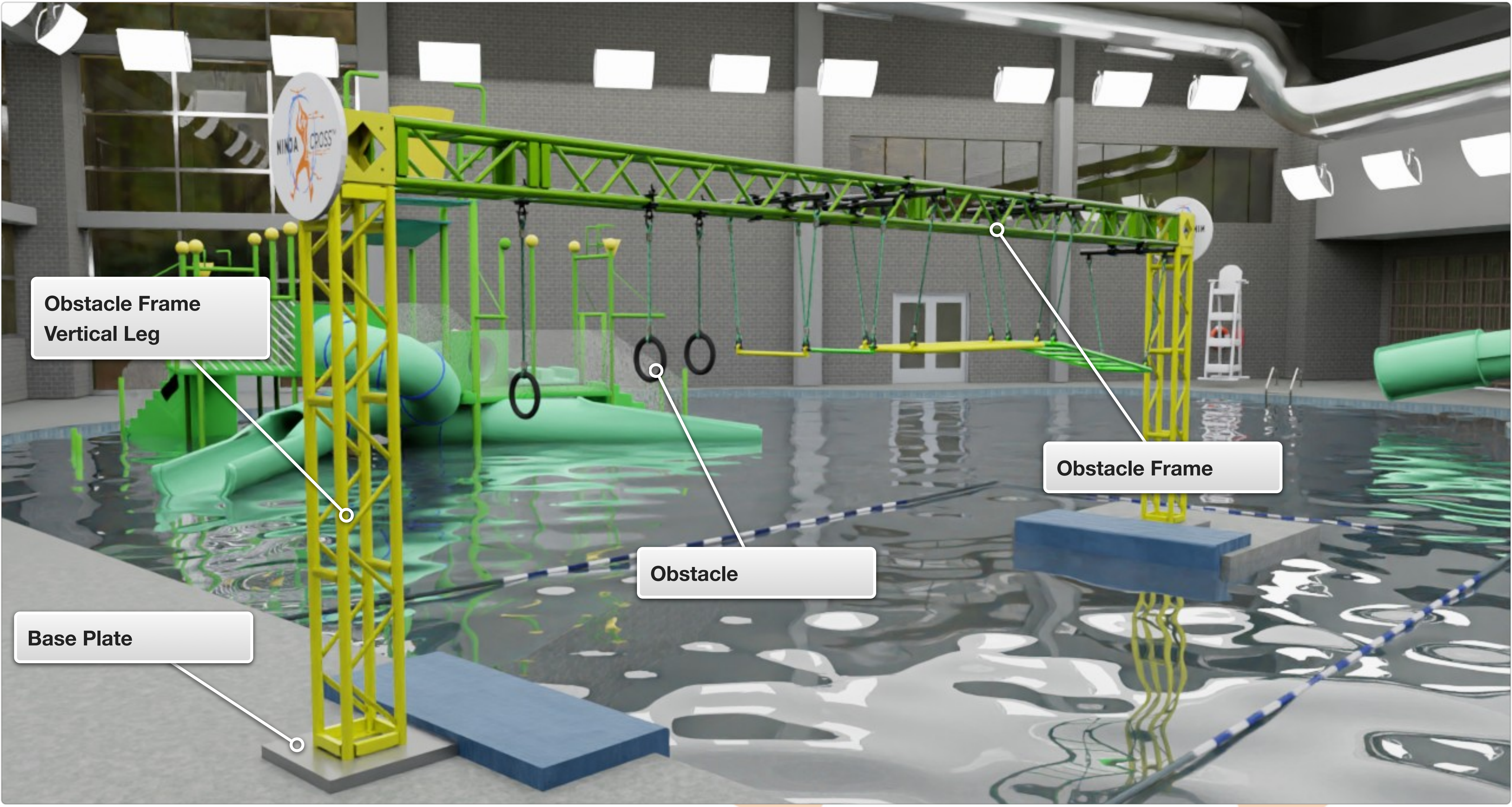
Aluminum Components

1. All metal Obstacles and OAB's
2. Obstacle Frame Truss and Corner Blocks
3. Truss Picks and Clamps

Other Materials

1. Signs - ABS
2. Backup System - powder-coated steel with galvanized cable
3. Ropes - InCord NetForm, Polyester Fiber Braided Steel Wire
4. Discs, Rings, and other Obstacles - HDPE

Interactive 8.1 System Overview



1 2 3 4

Section 2

Obstacle Frame Components

The Obstacle Frame consists of 3 primary components

1. 12”x12” Box Truss

2. 12” 6-way Corner Blocks

3. Mounting Plate

The parts of the Obstacle Frame System include:

1. **12”x12” Box Truss -** this aluminum box truss comprises the main structural component of the Obstacle Frame. Each section is at maximum 10’ long with the shortest being 2’ long. The type of Box Truss used is a bolt plate type that utilizes 5/8” bolt hardware.

2. **12”x12” 6-Way Corner Block -**is a 12” square block used to connect sections of Box Truss. The block is the only point where Static Lines are permitted to be installed.

3. **Mounting Plate -** this is a square aluminum plate designed to allow anchorage of the MiniNinja system to the concrete deck. The Mounting Plate is secured to the deck via wedge anchors and secured to the vertical Box Truss legs via bolting hardware.

Gallery 8.1 Obstacle Truss System

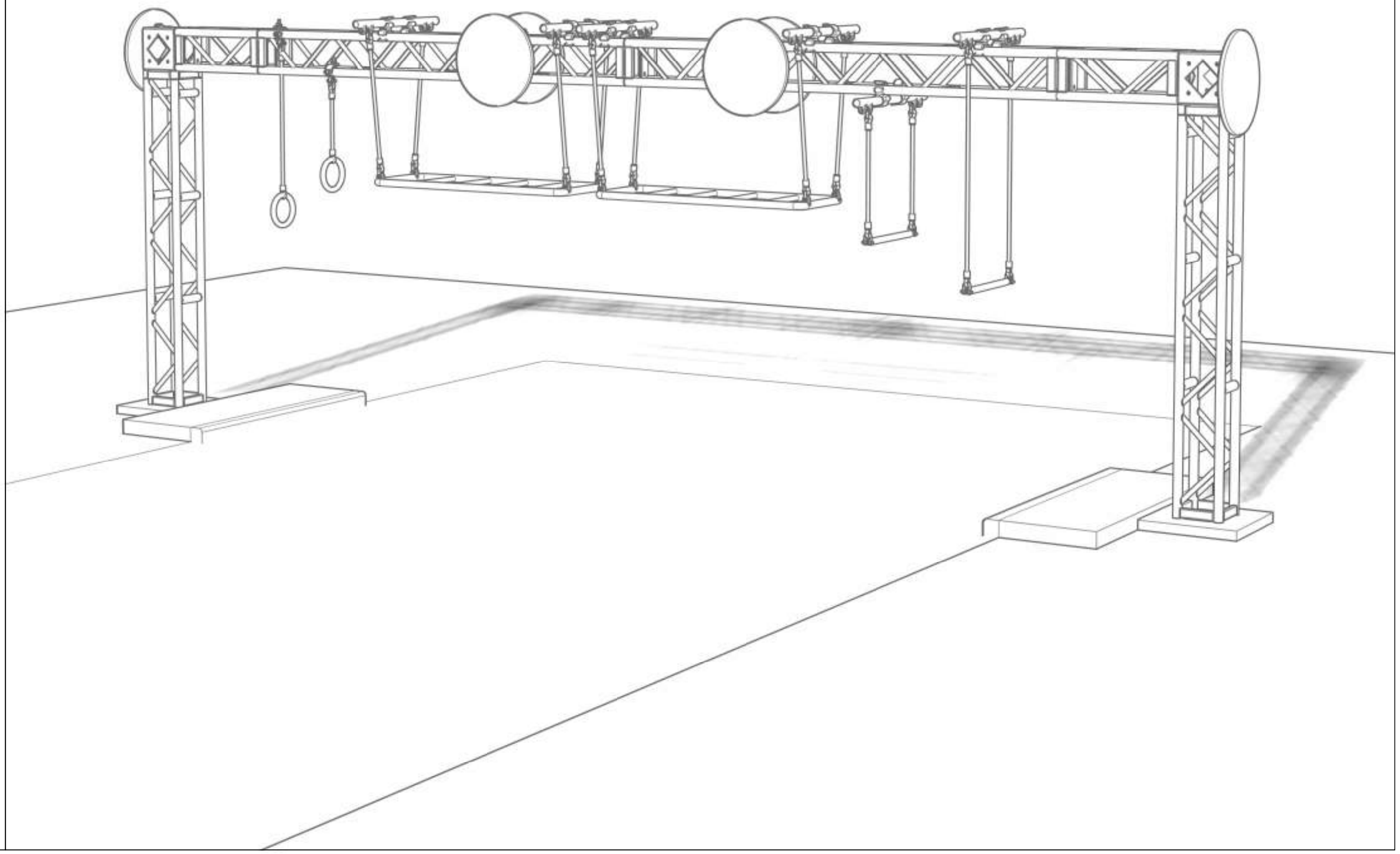
Corner Block

BASE PLATE AND ANCHOR NOTES:

FOR SLABS BETWEEN 4" AND 6" THICK:
INSTALL CUSTOM XSF BASE PLATE WITH (4) 5/8"Ø THREADED ROD ANCHORS IN AN 18" SQUARE PATTERN. EMBED 2¾" USING HILTI HIT-RE 500 V3 ADHESIVE.

FOR SLABS 6" THICK OR GREATER:
ANCHOR TRUSS DIRECTLY DOWN TO SLAB WITH (4) 5/8"Ø THREADED RODS AND HILTI HIT-RE 500 V3 ADHESIVE. USE A MINIMUM 4½" EMBEDMENT.

CONCRETE COMPRESSION STRENGTH SHALL BE 4000 PSI OR GREATER IN ALL CASES.



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THE STRUCTURAL SUPPORT SYSTEM DEPICTED ON THESE DRAWINGS WAS DESIGNED UNDER THE DIRECTION OF THE PROFESSIONAL ENGINEER WHO'S SEAL AND SIGNATURE ARE AFFIXED TO THIS DRAWING. THIS PROFESSIONAL ENGINEER DID NOT PERFORM ANY DESIGN OR REVIEW OF THE OTHER SYSTEMS SHOWN ON THESE DRAWINGS AND THEREFORE ASSUMES NO RESPONSBILTY FOR THIER ADEQUACY

PRELIMINARY
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TITLE: Cover Sheet		
PROJECT: LilyPad Replacement		**COUNTRY:**
DATE: 5/13/21	**PROJECT #:**	**STATE:**
SCALE:	**DESIGNER:** SPW	**COUNTY:**
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Comments/Notes
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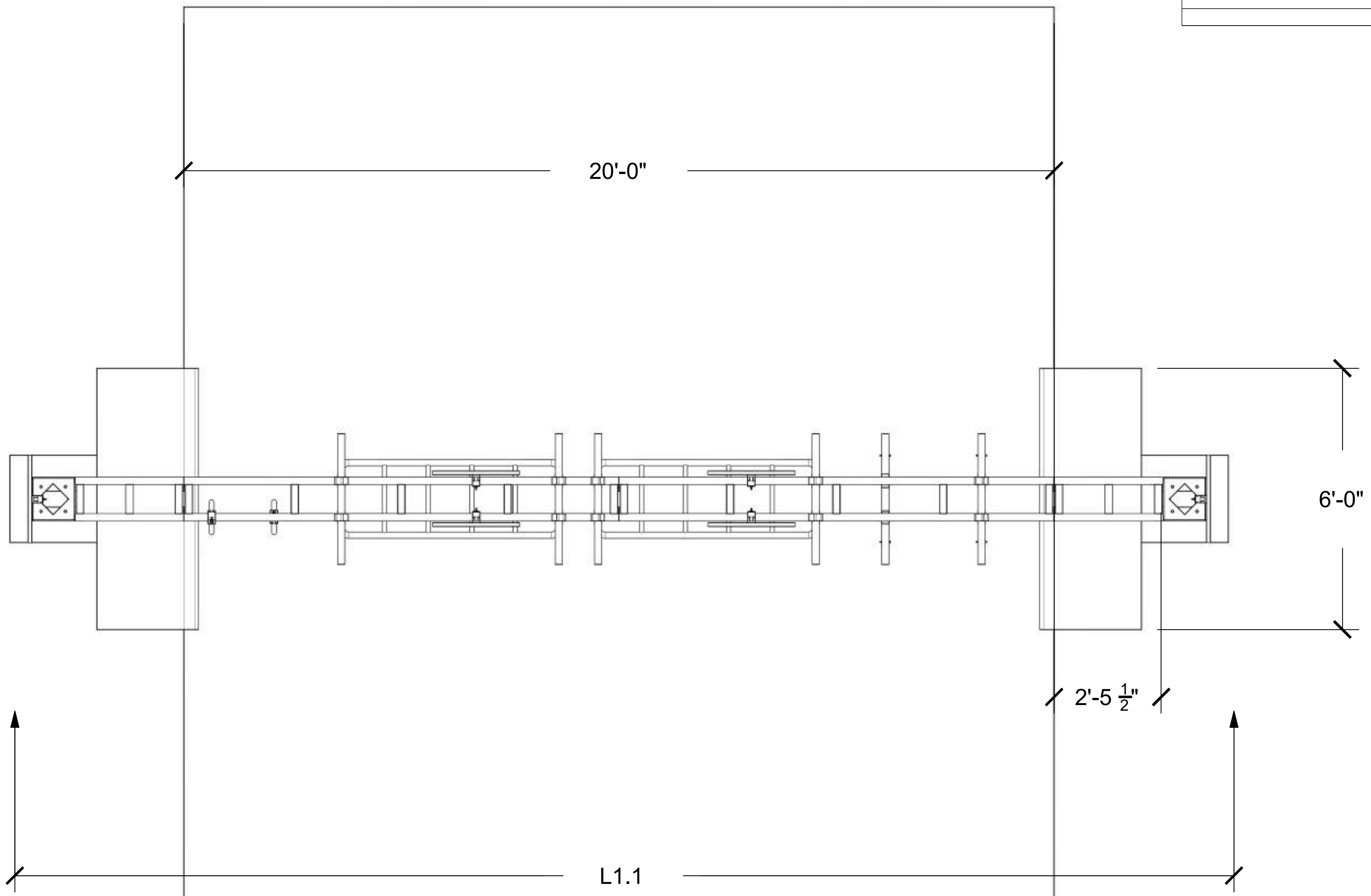

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TITLE: Layout		
PROJECT: LilyPad Replacement		**COUNTRY:**
DATE: 5/13/21	**PROJECT #:**	**STATE:**
SCALE:	**DESIGNER:** SPW	**COUNTY:**
CHECKED BY:	**APPROVED BY:**	**CITY:**

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Comments/Notes
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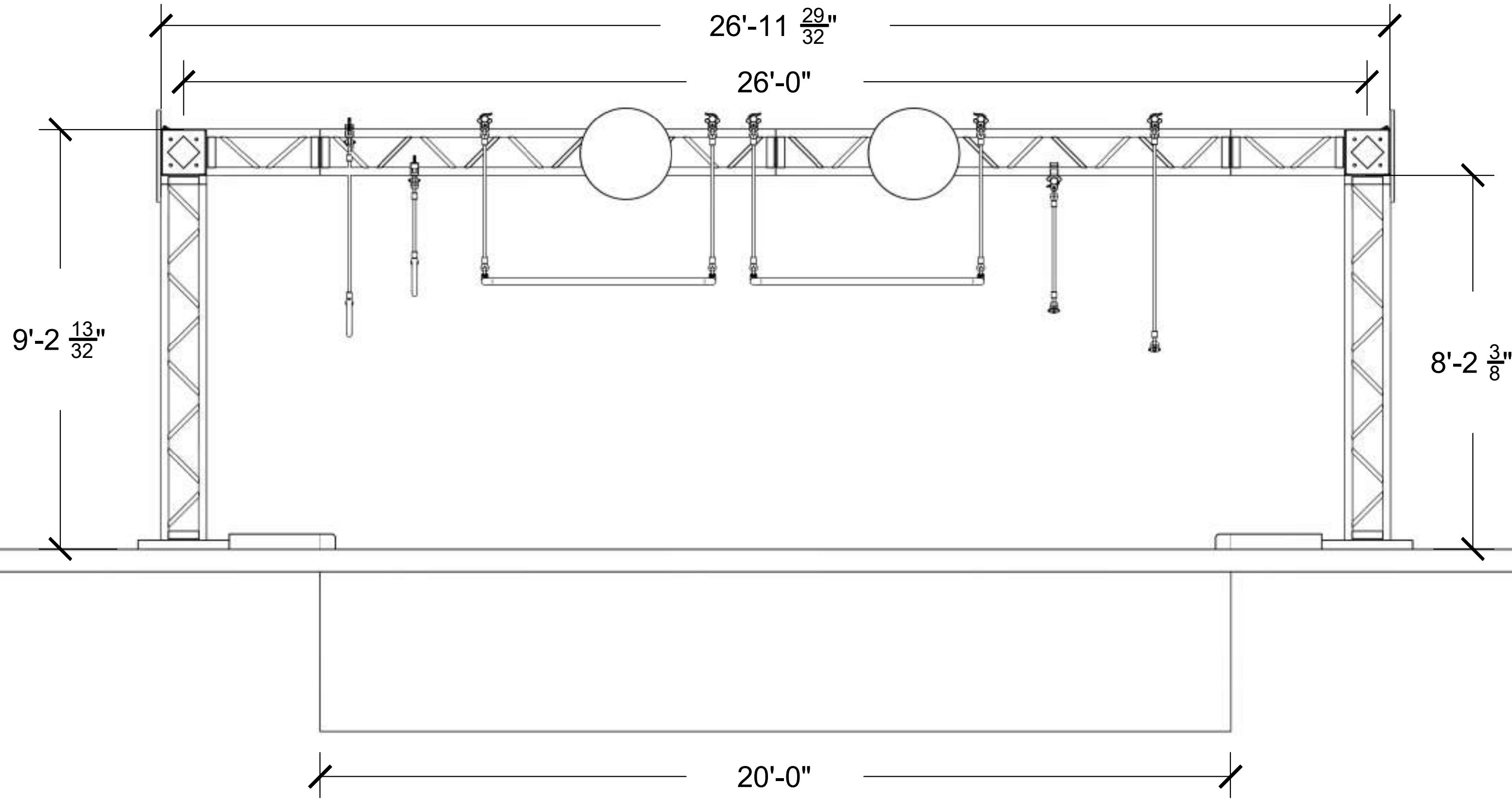

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PRELIMINARY
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TITLE: Layout		
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DATE: 5/13/21	**PROJECT #:**	**STATE:**
SCALE:	**DESIGNER:** SPW	**COUNTY:**
CHECKED BY:	**APPROVED BY:**	**CITY:**

NCS L1.1

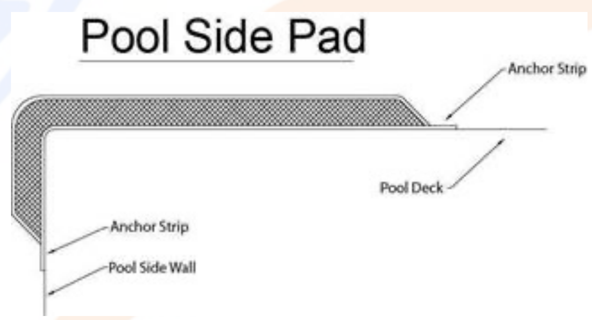
Disclaimers and Important Manufacturer Information

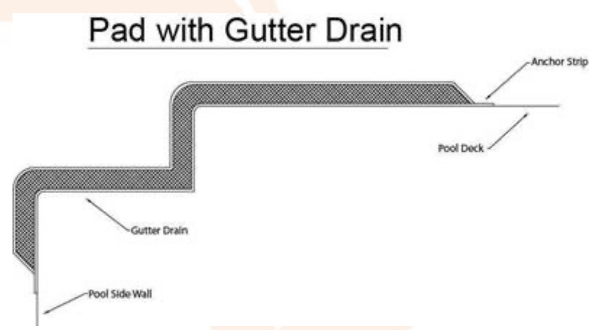
•The NinjaCross MiniNinja System & ancillary components require installation by qualified personnel. Use of non-qualified trades' people or use of non-approved parts will void the manufacturer's Warranty.

• NinjaCross MiniNinja maintenance is the responsibility of the owner. It is recommended a maintenance log be kept documenting water quality including all performed maintenance. See suggested inspection check lists, water quality log, and maintenance section for guidelines on how to maintain the system, in addition to keeping your Warranty valid. These documents may be called on if warranty issues arise.

•When receiving manufacturer shipments, inspect all items for damage and quantity immediately. Failure to do so could result in costly repair or replacement costs at the expense of the owner/installer. When receiving any shipments, be sure to inform the driver of any discrepancies and report as indicated on the shipping documentation when signing for receipt of goods. All claims must be reported within 48 hours of receipt of goods. Claims reported outside of this time cannot be guaranteed. If nothing has been noted on the Bill of Lading a claim may not be accepted. If you are unable to inspect the shipment at time of receipt you must note on the Bill of Lading "Subject to inspection".

•NinjaCross Systems does not supply the Safety Padding. Safety Padding is the sole responsibility of the Owner/ Operator. Pool Side Pads are designed to be placed on the side of the pool to protect patrons as they enter and exit the MiniNinja area. Pads typically form an L-Shape covering the length of your area and protect the top walk area, the pool side wall and the pool edge. Pads can also be made in a "stair-step" shape to protect pool walls with drain gutters.





WATER RECREATION VARIANCE REQUEST
YAKIMA AQUATIC CENTER AT MLK PARK

Washington State Department of HEALTH

State Board of Health
October 8, 2024

Introduction

David DeLong

Water Recreation Program Lead

David.delong@doh.wa.gov

@WADeptHealth

Background - Variances

WAC 246-262-160, Variance.

The board may grant a variance from requirements of chapter 246-262 WAC if, in the sole discretion of the board, data and/or research provides **sufficient evidence** that the recreational water contact facility (attraction, device, equipment, procedure, etc.), **will adequately protect public health and safety**, as well as water quality.

The request is to vary from:

- WAC 246-262-060(5)(b)(vi) requirement for a diving envelope
- WAC 246-262-010(21) definition of a diving envelope

3 features proposed:

- Aqua Climb climbing wall
- Aqua Zip'N rope swing
- Ninja Cross obstacle course

Affected WAC

WAC 246-262-010(21) Definition of a Diving Envelope

"Diving envelope" means the minimum dimensions of an area within the pool necessary to provide entry from a diving board, platform, or attraction segment where users enter above pool water level.

WAC 246-262-060(5)(b)(vi) General Design, Construction, and Equipment requirements for Diving Envelopes

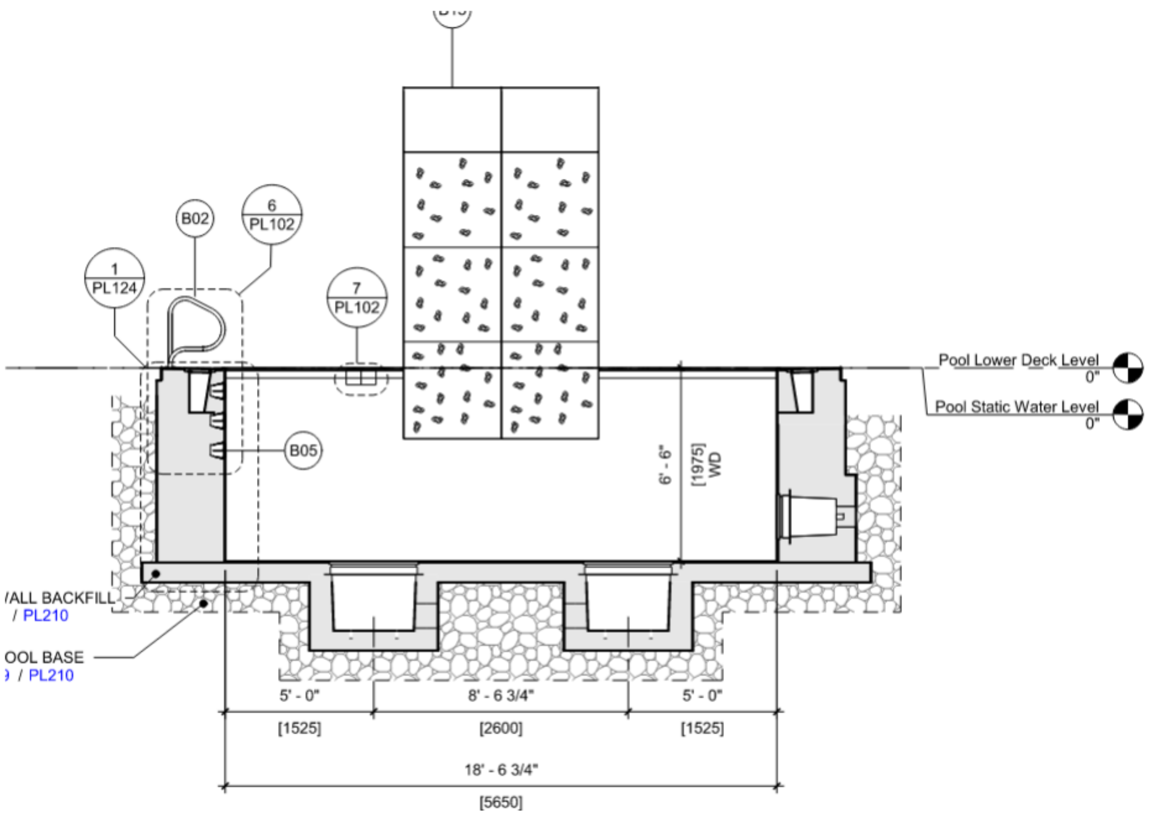
- Minimum Dimensions depending on diving deck level
- Handholds
- Ladders
- Nonslip tread
- Etc.

Aqua Climb – Installation MLK Park

- This feature is a climbing wall using the 3 high configuration.
- When used as expected, participants enter the water in a body orientation with the head up.
- It is designed with the expectation that participants may strike the pool bottom with their feet.
- Maximum participant velocity at recommended installation depth is 0.84 m/s.

Aqua Climb – Installation MLK Park Continued

- 3-High climbing section
  - CG Fall height = 35 inches
  - depth = 6.5 feet
  - Safety envelope depth = 6 FT
  - Velocity at safety envelope = 0.84 M/s
- Results are for the largest size participant.
- Participants may contact the pool bottom at install depths.



Summary & Recommendations - Aqua Climb

We believe this installation provides a similar level of risk as other typical uses of a pool because participants may contact the pool bottom, but at a very low velocity.

DOH recommends that the Board approve this variance request with conditions:

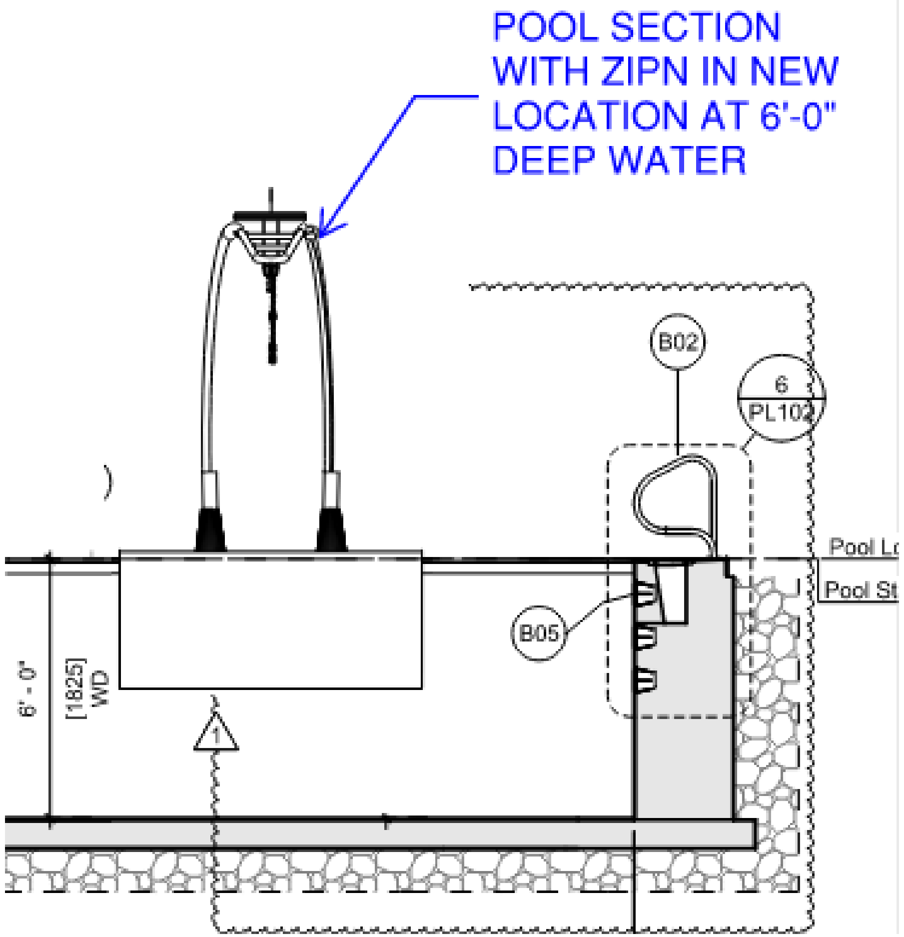
1. All manufacturer installation, maintenance, and use guidelines must be followed.
2. The Aqua Climb must be installed as shown on submitted plans with a minimum water depth of 6.5 ft.
3. Detailed rules signs must be provided, including the minimum and maximum user height and weight.
4. Only one user may be permitted to occupy the Aqua Climb at one time.
5. A dedicated lifeguard must be provided for the Aqua Climb climbing wall. The lifeguard must control the entry and exit of users.
6. The Aqua Climb climbing wall must be inspected daily and any identified maintenance issues must be addressed prior to opening the wall to users.
7. Lifeguard and operations plans must be developed and submitted to the local health jurisdiction prior to the issuance of a pool operating permit.

Aqua Zip'N – Installation MLK Park

- This feature is a rope swing/zipline.
- When used as expected, participants enter the water in a body orientation with the head up.
- It is anticipated that participants have the potential to strike the pool bottom with their feet when installed using the manufacture's recommended minimum water depth.

Aqua Zip'N – Installation MLK Park Continued

- Maximum handhold height = 87"
- Expected maximum fall = 2.43 ft
- Maximum depth penetration = 5.76 ft
- Maximum participant = 6 ft / 250 lbs
- Pool depth = 6.0 ft



Summary & Recommendations – Aqua Zip'N

We believe this installation meets the intent of providing a "diving envelope" because participants are unlikely to contact the pool bottom.

DOH recommends that the Board approve this variance request with conditions:

1. All manufacturer installation, maintenance, and use guidelines must be followed.
2. The Aqua Zip'N must be installed as shown on submitted plans with a minimum water depth of 6ft.
3. Detailed rules signs must be provided, including the minimum and maximum user height and weight.
4. Only one user may be permitted at one time.
5. A dedicated lifeguard must be provided for the Aqua Zip'N. The lifeguard must control the entry and exit of users.
6. The Aqua Zip'N must be inspected daily and any identified maintenance issues must be addressed prior to opening the wall to users.
7. Lifeguard and operations plans must be developed and submitted to DOH and the Local Health Jurisdiction prior to the issuance of a pool operating permit.

Ninja Cross – Installation MLK Park

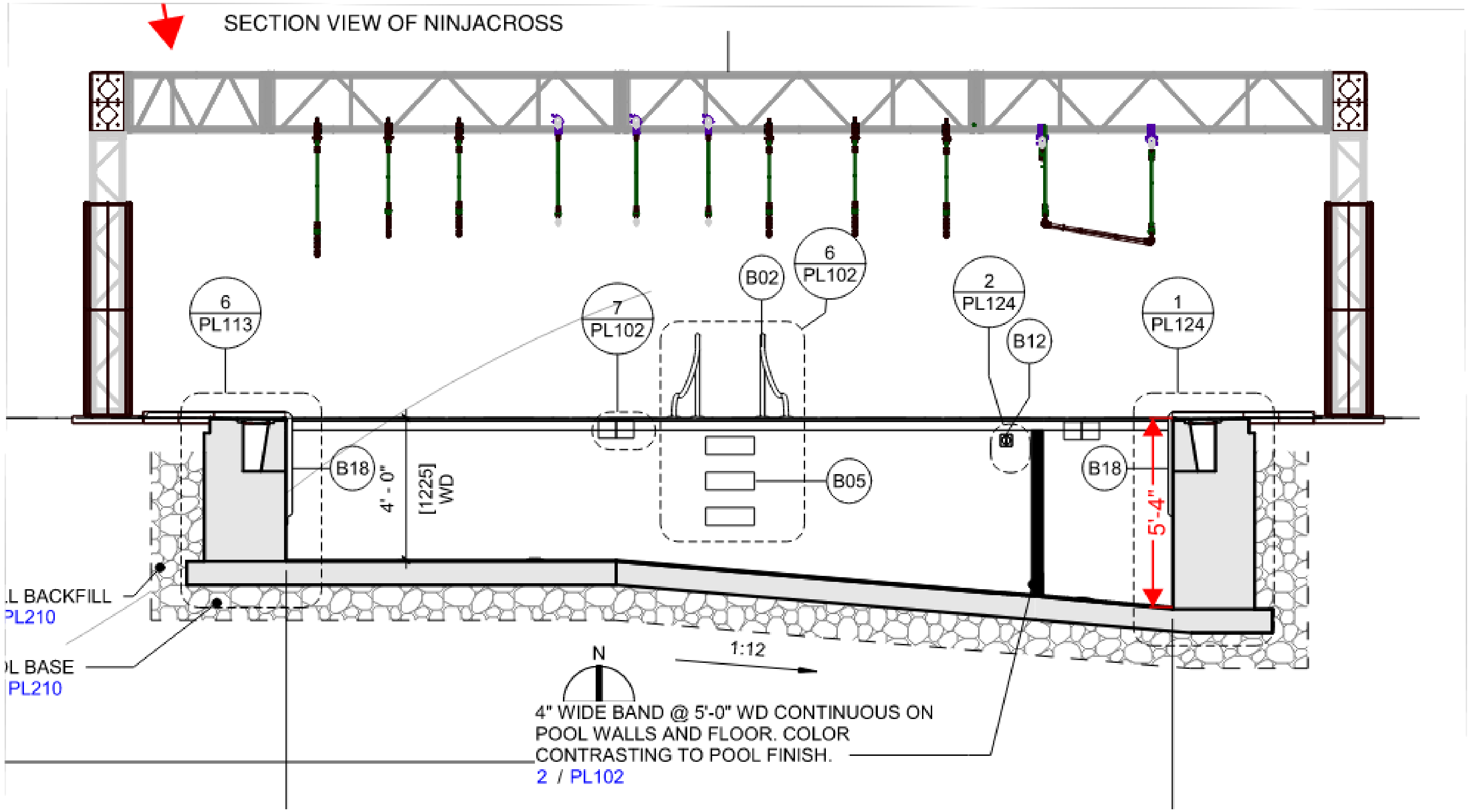
- This feature is an obstacle course with challenge elements suspended above the water.

- When used as expected, participants have part of their body in or touching the water.

- To ensure a “worst case scenario”, the engineering study assumed that participants begin their drop 20 inches above the water surface.

Ninja Cross – Installation MLK Park Continued

- Pool water depth = 4.0 ft – 5’ 4”
- Manufacture specified safe water depth = 3.5 ft
- Calculated impact velocity for maximum participant = 1.36 m/s



Ninja Cross - Evaluation

- Part of body in the water.
- Participants are expected to hit bottom.
- Maximum velocity on contact is 1.3 m/s.
- A variance may not be required because this feature is designed to have the user enter at or below water level.

Summary & Recommendations - Ninja Cross

WAC 246-262-010(21) - "Diving envelope" means the minimum dimensions of an area within the pool necessary to provide entry from a diving board, platform, or attraction segment where users enter above pool water level.

DOH determined after review of the Ninja Cross specifications that, since the starting position of the user is partially in the water, and not above pool water level, diving requirements do not apply, and this item may not need a variance. In addition, the velocity of participants when they contact the pool bottom is similar to the velocity of a “step-in” pool entry from the deck.

DOH recommends that the Board determine that installation of a Ninja Cross as specified complies with the rules and does not require a variance.

Safety Calculations

NinjaCross System Design Participant Results				
	Vertical Drop	Diagonal Drop	Tucked Knee Drop	Horizontal Drop
Velocity at Pool Bottom	2.9 mph	2.9 mph	1.8 mph	0.0 mph
Effective Height of Drop	3.4 in	3.4 in	1.3 in	0.0 in

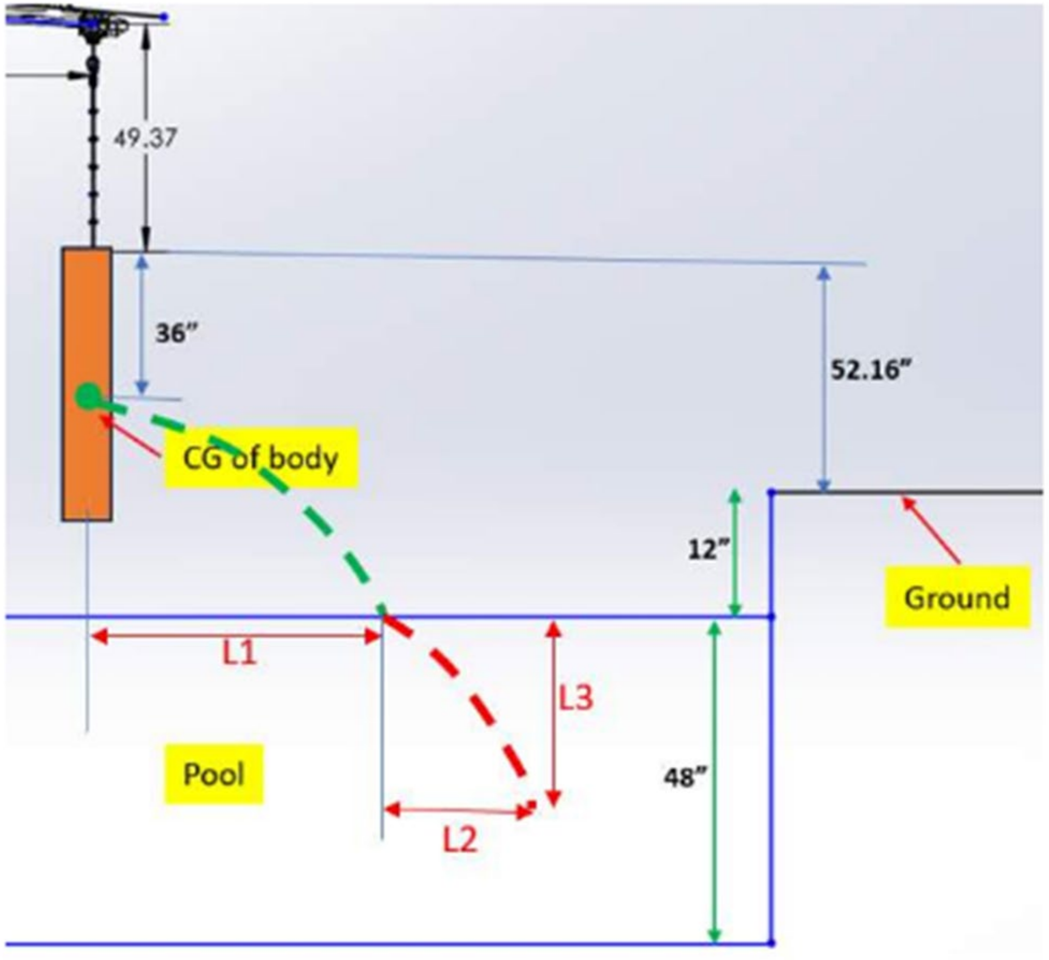
Aqua Climb Results for the largest participant

Model	Plummet Height (S_1)	Water Depth (S)	Calculated velocity at pool floor (V_2)	Benchmark velocity
3H	S_1 = 35" = 0.89m	S = 6' = 1.829m	0.84 m/s	2.99 m/s
3H Alt	S_1 = 25" = 0.64m	S = 5' = 1.524m	0.90 m/s	2.99 m/s
4H	S_1 = 73" = 1.85m	S = 7' = 2.134m	1.35 m/s	2.99 m/s
4H Alt	S_1 = 63" = 1.60m	S = 6' = 1.829m	1.63 m/s	2.99 m/s
5H	S_1 = 112" = 2.84m	S = 9' = 2.743m	1.00 m/s	2.99 m/s
5H Alt	S_1 = 102" = 2.59m	S = 8' = 2.438m	1.35 m/s	2.99 m/s

Safety Calculations Continued

Calculation Results:

- Before touching the water, the body can move in horizontal direction L1 = 4.75 ft
- The max moving distance in horizontal direction in the water is about L2 = 2.76 ft
- The max depth in the water is about L3 = 2.76 ft
- Note: If counting the body height 6ft, the max depth in the water would be 5.76 ft



Washington State Department of
HEALTH

THANK YOU!

To request this document in another format, call 1-800-525-0127. Deaf or hard of hearing customers, please call 711 (Washington Relay) or email civil.rights@doh.wa.gov.

Calculation Report

Hand Calculation on AquaClimb

PROJECT INFO.

Change History:

Version Number	Date	Prepared by	Reviewed by	Contact
V 1.0	8/30/2024	Bill Bin	Frank Wang	Frank.Wang@feamax.com

CFD Requestor Info.:

Contact name:	Alex Salzman
Email:	Alex@PoolsideAdventures.com
Company name:	PYRAMIDE USA INC.
Address:	PO Box 530. Frederick, MD 21705

PROJECT DESCRIPTION

Project Description:

1. Perform hand calculations on the trolley system with the 6 cases.
2. Calculate the velocity at the water depths shown in the chart. And then compare that to the benchmark velocity.
3. The average vertical jump height of an untrained male = 16-20”. Assume the benchmark velocity to be a 6’ 250lb person jumping 18” above the ground on the sidewalk. The velocity that they hit the sidewalk is our benchmark velocity. No water. A person can jump into the air and land back on the ground safely and the body can be reasonably expected to safely support that. That’s the benchmark.
4. All related documents were received by 8/25/2024

LOAD CASES

Load Case:

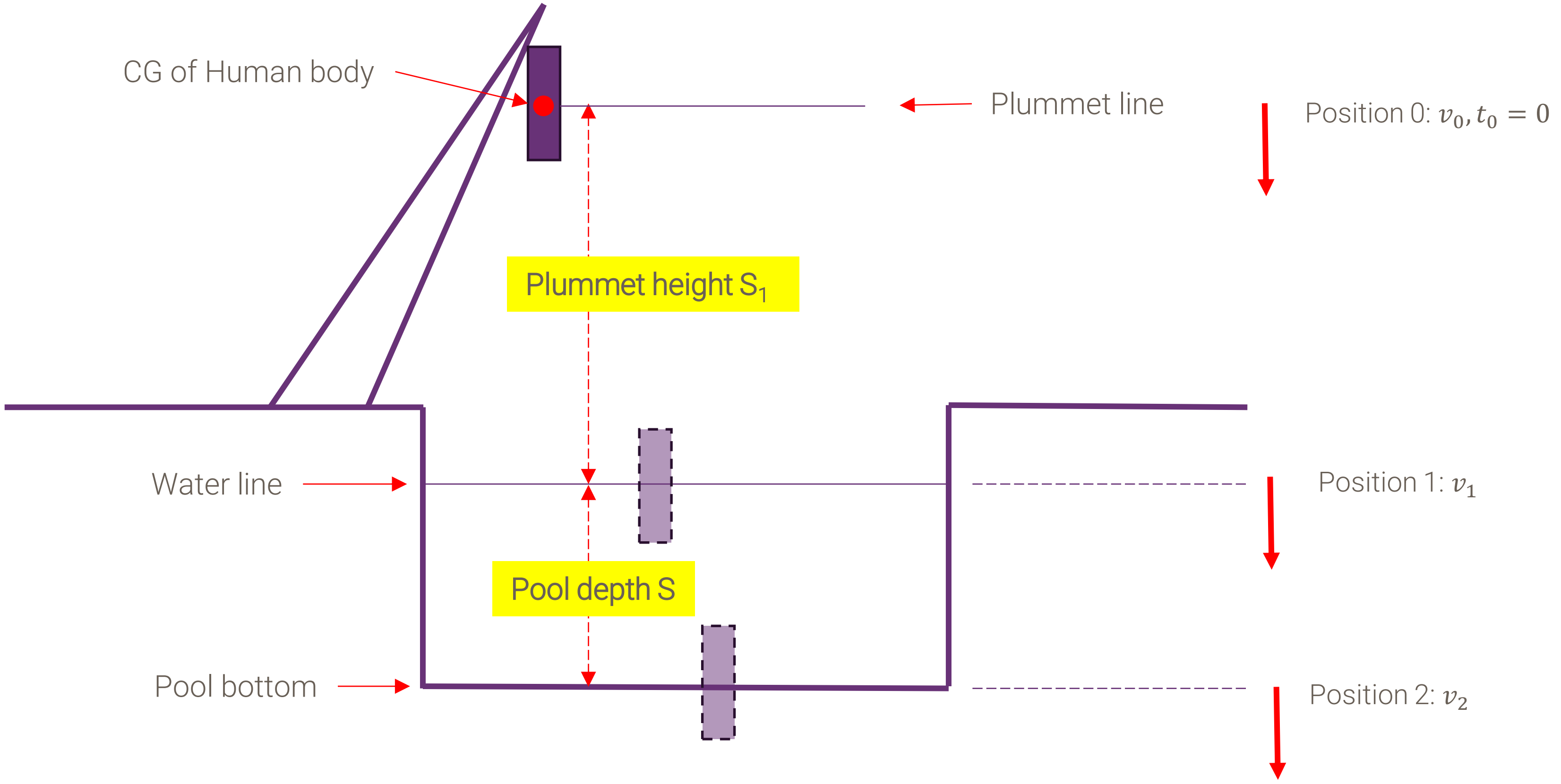
1. The calculations show the center of gravity in the water. Climbing wall chart below.

Model	Water Depth	Highest Handhold above deck level	Minimum Plummet: 48" person, 50lbs (highest foot hold 36" below handhold)	Maximum Plummet: 72" person, 250lbs (highest foothold 48" below handhold)
3H	6'	83	47	35
3H Alt	5'	73	37	25
4H	7'	121	85	73
4H Alt	6'	111	75	63
5H	9'	160	124	112
5H Alt	8'	150	114	102

CALCULATION MODEL

Calculation Model:

1. We chose the CG of human in the calculation. The Plummet Height is the distance between CG and water line.



ASSUMPTIONS

Assumptions and Load Condition:

1. Water density ρ_{water} = 1.0 g/cm^3
2. Human body density ρ_{human} = 0.9 g/cm^3
3. Human body volume = V
4. Human body mass = m
5. The velocity enter the water = V_1
6. Water Resistance coefficient C_D = 1.0
7. Cross-section area of human body enter the water = A
8. The height of human body = H
9. Velocity of human body inside the water = V_x
10. The allowable decent velocity to the pool bottom = V_2
11. Option#1: Minimum H = 48" person, 50lbs
12. Option#2: Minimum H = 72" person, 250lbs

ASSUMPTIONS

Assumptions and Load Condition:

Option #1 - Minimum 48" person, 50lbs:

1. m = 50 lbs = 22.68kg
2. ρ_{human} = 0.9 g/cm^3
3. H = 48" = 1.22 m
4. Human body volume V = m/ρ_{human} = 0.0252 m^3.
5. Assume the cross-section area of human body A = 0.03 m^2.

Option #2 - Minimum 72" person, 250lbs:

1. m = 250 lbs = 113kg
2. ρ_{human} = 0.9 g/cm^3
3. H = 72" = 1.83 m
4. Human body volume V = m/ρ_{human} = 0.125 m^3.
5. Assume the cross-section area of human body A = 0.12 m^2.

CALCULATION

Calculation

Calculate the benchmark velocity:

1. Assume the benchmark velocity to be a 6’ 250lb person jumping 18” above the ground on the sidewalk. The velocity that they hit the sidewalk is the benchmark velocity.
2. $V_1^2 = 2 \times 9.8 \times S_1$
3. S_1 = 18” = 0.457m
4. The benchmark velocity V_1 = 2.99 m/s

CALCULATION

Calculation

Force applied to human body inside water:

1. Gravity $G = \rho_{human}\, gV$
2. Buoyancy (floating force) F = $\rho_{water}\, gV$
3. Water resistance force $F_{resistance} = 1/2\ \rho_{water}\, {V_x}^2\, AC_D$

According to Newton's second law, we have:

1. The acceleration in the water: $a = \frac{dV_x}{dt} = \frac{F}{m}$
2. $a = \frac{\rho_{human} gV - \rho_{water} gV - \frac{1}{2}\rho_{water} V_x^2 AC_D}{\rho_{human} V} = \frac{0.9\times 9.8\times V - 1.0\times 9.8\times V - 0.5\times 1.0\times V_x^2\times A\times 1.0}{0.9\times V} = -(1.09 + 0.56\frac{A}{V}V_x^2)$
3. $\frac{dV_x}{dt} = -(1.09 + 0.56\frac{AV_x^2}{V})$
4. $\mathrm{dt} = -\frac{dV_x}{(1.09 + 0.56\frac{AV_x^2}{V})}$

CALCULATION

Calculation

The displacement for body moving inside the water would be:

$$S = \int_0^t V_x \cdot dt = -\int_{V_2}^{V_1} V_x \cdot \frac{dV_x}{1.09 + 0.56\frac{AV_x^2}{V}}$$

$V_1^2 = 2 \times 9.8 \times S_1$

RESULTS

Results:

For minimum 48” person, 50 lbs (H = 48” = 1.2 meter), we have:

$$S = \int_0^t V_x \cdot dt = -\int_{V_2}^{V_1} V_x \cdot \frac{dV_x}{1.09+0.56\frac{AV_x^2}{V}};$$

A = 0.03 m^2 V = 0.0252 m^3 $V_1^2 = 2 \times 9.8 \times S_1$

Model	Plummet Height (S_1)	Water Depth (S)	Calculated velocity at pool floor (V_2)	Benchmark velocity
3H	S_1 = 47” = 1.19m	S = 6’ = 1.829m	0.74 m/s	2.99 m/s
3H Alt	S_1 = 37” = 0.94m	S = 5’ = 1.524m	0.99 m/s	2.99 m/s
4H	S_1 = 85” = 2.16m	S = 7’ = 2.134m	0.96 m/s	2.99 m/s
4H Alt	S_1 = 75” = 1.91m	S = 6’ = 1.829m	1.33 m/s	2.99 m/s
5H	S_1 = 124” = 3.15m	S = 9’ = 2.743m	0.15 m/s	2.99 m/s
5H Alt	S_1 = 114” = 2.90m	S = 8’ = 2.438m	0.80 m/s	2.99 m/s

RESULTS

Results:

For Minimum 72" person, 250lbs (H = 72" = 1.83 meter), we have:

$$S = \int_0^t V_x \cdot dt = -\int_{V_2}^{V_1} V_x \cdot \frac{dV_x}{1.09+0.56\frac{AV_x^2}{V}};$$

$A = 0.12\ m^2$

$V = 0.125\ m^3$

$V_1^2 = 2 \times 9.8 \times S_1$

Model	Plummet Height (S_1)	Water Depth (S)	Calculated velocity at pool floor (V_2)	Benchmark velocity
3H	S_1 = 35" = 0.89m	S = 6' = 1.829m	0.84 m/s	2.99 m/s
3H Alt	S_1 = 25" = 0.64m	S = 5' = 1.524m	0.90 m/s	2.99 m/s
4H	S_1 = 73" = 1.85m	S = 7' = 2.134m	1.35 m/s	2.99 m/s
4H Alt	S_1 = 63" = 1.60m	S = 6' = 1.829m	1.63 m/s	2.99 m/s
5H	S_1 = 112" = 2.84m	S = 9' = 2.743m	1.00 m/s	2.99 m/s
5H Alt	S_1 = 102" = 2.59m	S = 8' = 2.438m	1.35 m/s	2.99 m/s

CONCLUSION

Conclusions:

1. For minimum 48” person, 50 lbs (H = 48” = 1.2 meter): the calculated velocity at the pool floor is between 0.15 m/s and 1.33 m/s for all 6 cases.
2. For minimum 72" person, 250lbs (H = 72” = 1.83 meter): the calculated velocity at the pool floor is between 0.84 m/s and 1.35 m/s for all 6 cases.
3. All the calculated velocities at pool floor are less than the benchmark velocity 2.99 m/s.
4. Comparing to the benchmark velocity, all the 12 cases with the provided water depth would be safe.

COMMENTS

Comments:

1. In this hand calculation, we assume that the human body density is approximately 0.9 g/cm^3 (with breath held) and that the water resistance coefficient is around 1.0 under normal conditions. If the actual parameter values differ from these assumptions, the calculated results may vary accordingly.
2. We assume the benchmark velocity to be a 6' 250lb person jumping 18" above the ground on the sidewalk. The calculated velocity that they hit the sidewalk (2.99 m/s) is the benchmark velocity.

Washington State Board of Health
Policy & Procedure

Policy Number:	**2018-001**
Subject:	**Handling Variances, Exemptions, and Waivers in State Board of Health Rules**
Approved Date:	**August 8, 2018**

Background

The State Board of Health (Board) has broad authority to adopt rules on a number of public health and safety topics. These rules may include provisions regarding variances, exemptions, or waivers allowed under the rules, which may be granted by the Washington Department of Health (Department), local health jurisdictions, or the Board.

Variances, exemptions, and waivers are different types of exceptions that support flexible and reasonable application of Board rules depending on the particular situation. The terms are not defined in the regulations referenced below, but the general dictionary definitions of these words can be used to understand the distinctions between them:

- **Variance** means a modified means of meeting a rule requirement.
- **Exemption** means relief from a rule requirement.
- **Waiver** means the setting aside of a rule requirement.

As outlined in Table 1 of this policy, one or more of these exception provisions are used in twelve Board rules. In addition, state rules on reclaimed water administered by the Washington Department of Ecology reference Board waiver authority in chapter 246-290 WAC, *Group A Public Water Supplies*, for approval of direct potable reuse of reclaimed water.

In most cases, authority to grant exceptions is assigned to the Department, local board of health, or local health officer. Only three rules directly involve the Board. Two rules assign decision-making authority to the Board and a third provides the Board with optional approval authority:

1) WAC 246-262-160: Authorizes the Board to act on variance requests to requirements of chapter 246-262 WAC, *Recreational Water Contact Facilities*.
2) WAC 246-290-060: Authorizes the Board to act on requests for variances, exemptions, or waivers to requirements of chapter 246-290 WAC, *Group A Public Water Supplies*.
3) WAC 246-260-201: Authorizes the Department or local health officer to act on variance requests to requirements of chapter 246-260 WAC, *Water Recreation Facilities*. However, the Board may require that variance requests be submitted for Board review and approval.

Policy Statement

Variances, exemptions, and waivers are valuable tools in Board rules. The Board plays a limited role directly granting such exceptions in implementing the rules. Where required in rules, the Board will consider requests for variances, exemptions, and waivers under the procedure outlined below.

New or revised Board rules can help refine the Board's limited role granting these exceptions and help align provisions for variances, exemptions, and waivers across Board rules. The following should be taken into consideration as Board rules containing these provisions are next updated:

- Variances, exemptions, and waivers should be clearly defined and correctly applied in all Board rules.
- Approval authority for variances, exemptions, and waivers should rest with the health agency where it best protects public health and safety, ensures accountability, and is most easily administered.
- Unless it provides needed flexibility, rules granting variances, exemptions, or waivers should avoid listing multiple or optional approval authorities and should instead authorize one agency.
- For ease of administration, rules authorizing local health jurisdictions to approve variances, exemptions, or waivers should identify local health officers rather than local boards of health as the approval authority.
- Provisions in chapter 246-260 WAC and chapter 246-262 WAC should be aligned—or combined if the rules are consolidated—and should assign approval authority to either the Department or local health officer.
- Where meaningful, annual reporting to the Board on activity related to variances, exemptions, and waivers can be required. If required, such reporting should occur consistently.

Board Procedure

Where required in rule, the Board will consider requests for variances, exemptions, and waivers. As noted previously, two rules require Board action: chapter 246-262 WAC, *Recreational Water Contact Facilities*, and chapter 246-290 WAC, *Group A Public Water Supplies*. Chapter 246-262 WAC lacks any process requirements, so the following procedures apply in full. In contrast, WAC 246-290-060 and Policy J.28 of the Department's Office of Drinking Water outline a few process requirements that should be applied to dovetail with Board process requirements starting at the point of application to the Department. Variance and exemption requests under WAC 246-290-060 must be considered in accordance with 40 CFR s. 141.4 (variances and exemptions to National Primary Drinking Water Regulations).

Submittal of Requests

Requests should be addressed to the Board Chair and signed by an authorized agent of the owner/operator of the facility or utility (not a third-party agent). With applications to the Department of Health under WAC 246-290-060, the Board Chair should be copied. The request should include and describe the following:

- name and address of the facility or utility, name of the owner/operator, and name and information for the lead contact;
- rule citation authorizing Board action;
- the specific rule or rules for which a variance, exemption, or waiver is sought;
- the situation, need, and justification for the request;
- supporting documentation and technical analysis developed or used to assess the request and meet the intent of the regulation to ensure health and safety;
- steps taken to mitigate concerns or risks; and
- commitment to carry out conditions or follow–up actions that may be applied to the request.

Receipt and Notification

Upon receipt of a request, Board staff, in consultation with the Executive Director, will respond to the requester within five business days acknowledging receipt of the request. The Executive Director or staff will notify Board members that a request has been received and will be brought to the Board for consideration at the next regularly scheduled Board meeting. The Board will strive to complete its work and respond to a request within 60 days. If no regular meeting is scheduled within 60 days of receipt, or if the agenda for the regular meeting cannot accommodate review of the request, or if staff need more time to complete its review, the request may be addressed at the following Board meeting. The Executive Director or staff will notify the requester of dates and times that the Board is scheduled to meet and consider the request. As part of its initial review, the Board will determine whether a request falls within its authority to review. If the Board determines that a request falls outside the scope of its authority, staff will notify the requester of this and close the request.

Review and Board Action

The Board may identify a sponsoring Board member and will direct staff to review the request on the basis of relevant laws, industry standards, health and safety guidelines, and other relevant material. Board staff will coordinate and consult with the Department and other subject matter experts as appropriate in reviewing the request.

The sponsor and Board staff assigned to review the request will present their findings and recommendation to the Board. The Board may ask a Department representative to provide a recommendation or technical analysis to help inform Board discussions. The Board may invite the requester to present the request and respond to questions from the Board at its meeting.

Following review, the Board may grant the request, grant the request with conditions, deny the request, or ask for additional information before acting on the request. The Board may grant a variance, exemption, or waiver from rule requirements if it meets the substantive requirements of the rule allowing a variance, exemption, or waiver. Variances and exemptions granted to public water systems must be conditioned on a compliance schedule in accordance with WAC 246-290-060(6). The decision will be made by the Board in public meeting. Once the Board has made its decision, Board staff will follow up with a written notice to the requester. If the Board denies a request, the notice will contain information about how the requester may appeal the decision.

WAC 246-262-010 Definitions, abbreviations, and acronyms. The definitions in this section apply throughout this chapter unless the context clearly indicates otherwise.

(1) "Advanced first aid" means a course of instruction recognized by the American Red Cross, department of labor and industries, the U.S. Bureau of Mines, or fire services training program.

(2) "ANSI" means American National Standard Institute.

(3) "Approved" means the department or local health officer has stated in writing that the design plans and specifications are in accordance with chapter 246-262 WAC.

(4) "ARC" means American Red Cross.

(5) "Architect" means a registered architect currently licensed under chapter 18.08 RCW in Washington state.

(6) "APSP" means Association of Pool and Spa Professionals.

(7) "ASTM" means American Society for Testing Material.

(8) "Attendant" means a person trained to operate an attraction and control the users in a safe orderly manner.

(9) "Attraction or ride" means any of the specific types of recreational facilities involving partial or total immersion or intentional contact with the water designated for public recreational use.

(10) "Biomechanics" means the study of the human body as a system operating under the laws of Newtonian mechanics and the biological laws of life.

(11) "Board" means the state board of health.

(12) "Boogie or mini-surf board" means any semirigid device used in a wave pool for flotation or as a riding device.

(13) "Branch line" means suction piping between a junction fitting and a suction outlet.

(14) "Centerline" means the path defined by geometric midpoints of a component or structure, generally used in consideration of the slide path in flume rides.

(15) "CNCA" means Council for National Cooperation in Aquatics.

(16) "Communication system" means any combination of devices permitting the passage of or exchange of messages between park operating personnel and between operating personnel and users. Systems can include, but are not limited to, two-way radios, hardwired intercoms, horns, whistles, hand signals, direct voice, signs, or equivalent.

(17) "Contaminant" means any physical, chemical or biological substance present in the RWCF water which may adversely affect the health or safety of the user and/or the quality of the water.

(18) "Cross-connection" means any physical arrangement connecting:

(a) A potable water system directly or indirectly, with anything other than another potable water system; or

(b) A RWCF to any potable or nonpotable water source capable of contaminating either the RWCF or potable water source as a result of backflow.

(19) "Department" means the Washington state department of health.

(20) "Discharge section" means the component or components making up the exit of the water slide, water tube, inner tube ride, speed slide, ramp slide, drop slide or drop tube, or kiddie flume. These components are the elements controlling the final direction and speed of the user.

(21) "Diving envelope" means the minimum dimensions of an area within the pool necessary to provide entry from a diving board, platform, or attraction segment where users enter above pool water level.

(22) "Drop slide or drop tube ride" means a sloped trough, chute, or tube exiting the user above the pool operating water level.

(23) "Engineer" means a registered professional engineer currently licensed under chapter 18.43 RCW in Washington state.

(24) "Entry access points" means the areas where users enter an attraction.

(25) "Entry rate" means the frequency at which users are permitted access to the attraction.

(26) "Equalizer line outlet" means a suction outlet located on the pool wall below the waterline and connected by pipe to the body of a skimmer to prevent air from being drawn into the pump if the water level drops below the skimmer weir.

(27) "Ergonomics" means a multidisciplinary activity dealing with the interactions between humans and their environment plus the traditional environmental elements atmosphere, heat, light, and sound, as well as objects with which the user comes in contact.

(28) "FINA" means Federation Internationale de Natation Amateur.

(29) "Flume or tube entry" means the area at which users enter a water slide, water tube, inner tube ride, speed slide, drop slide, drop tube, or kiddie flume.

(30) "fps" means feet per second.

(31) "gpm" means gallons per minute.

(32) "IAAPA" means International Association of Amusement Parks and Attractions.

(33) "Injury or illness report" means the written record of all facts regarding an injury or illness associated with the RWCF.

(34) "Inner tube ride" means an attraction where users ride inner tube-like devices through a series of chutes, channels, flumes, and pools.

(35) "Innovative recreational water contact facility" means any type of RWCF currently unregulated.

(36) "Intermediate pool" means any pool between the entry and exit pools in attraction using a series of pools.

(37) "Junction fitting" means a pipe fitting in the shape of a "T" or a "Y" used to connect suction outlets to a pump or a balancing tank, and provides two branch line connections and one trunk line connection.

(38) "Kiddie flume or tube attraction" means a flume, chute, or tube designated for and restricted to use by small children.

(39) "Lifeguard" means an individual currently certified by red cross in advance lifesaving or lifeguard training, or YMCA senior lifesaver, or equivalent certification through the royal Canadian lifeguard services.

(40) "Lifeguard station" means the designated work station of the lifeguard.

(41) "Local health officer" means the health office of the city, county, or city-county department or district or a representative authorized by the local health officer.

(42) "Main drain" means a submerged suction outlet for transferring water from a recreational water contact facility.

(43) "mg/l" means milligrams per liter.

(44) "Multiactivity pool" means a pool with more than one type of attraction (i.e., an adult activity pool with a series of tubes, chutes, cable rides, etc., intended for use by individuals with specific swimming abilities).

(45) "NSF" means National Sanitation Foundation.

(46) "NSPI" means National Spa and Pool Institute.

(47) "Operating levels" means water levels maintained within attractions during use for proper operation of facility and for controlling safety and sanitation.

(48) "Operations" means all aspects of a RWCF, which must be controlled to make the facility safe, healthy, and usable for the purpose intended.

(49) "Owner" means a person owning and responsible for a RWCF or authorized agent.

(50) "Person" means an individual, firm, partnership, co-partnership, corporation, company, association, club, government entity, or organization of any kind.

(51) "Ponding" means a condition where water fails to drain from walking surfaces.

(52) "ppm" means parts per million.

(53) "Primary zone of visual coverage" means the area assigned to a lifeguard or attendant for primary visual surveillance of user activity.

(54) "Radius of curvature" means the radius arc which denotes the curved surface from the point of departure from the vertical sidewall (springline) of the pool to the pool bottom.

(55) "Ramp slide" means a slide allowing one or more users to slide in unison down a straight incline to a runout or a receiving pool.

(56) "Recirculation filter water" means water which is recirculated by the RWCF for treatment purposes, i.e., filtration and disinfection.

(57) "Response time" means elapsed time between bather distress and initiation of rescue assistance by a lifeguard (or attendant where applicable).

(58) "RWCF" means recreational water contact facility which is an artificial water associated facility with design and operational features that provide patron recreational activity which is different from that associated with a conventional swimming pool and purposefully involves immersion of the body partially or totally in the water and includes, but is not limited to, water slides, wave pools, and water lagoons.

(59) "Secretary" means the secretary of the department.

(60) "Serious injury" means any injury requiring admission to a hospital.

(61) "Speed slide or speed tube" means a sloped trough, flume, tube, or roller track having long straight and/or steep drops where users sustain speeds of 20 miles per hour or more.

(62) "Springline" means the point from which the pool wall breaks from vertical and begins its arc in the radius of curvature (for coved construction) to the bottom of the pool.

(63) "Suction fitting standard" means the ANSI/APSP-16 2011, Suction Fittings for Use in Swimming Pools, Wading Pools, Spas, and Hot Tubs or the ANSI/APSP/ICC-16 2017, American National Standard for Suction Outlet Fitting Assemblies (SOFA) for Use in Pools, Spas and Hot Tubs.

(64) "Suction outlet" means a fitting; fitting assembly and related components, including the sump or bulkhead fitting, cover, and hardware that provides a localized low pressure area for the transfer of water from a recreational water contact facility. Types of suction outlets include main drains and equalizer line outlets.

(65) "Surfboard" means a rigid device used in a wave pool for riding.

(66) "Tail coverage" means providing insurance coverage for a given period of time for discovery of claims made after the policy term for "claims made" type of insurance.

(67) "Total turnover" means the time it takes for the pool attraction water volume to be recirculated as a sum of the flows from treatment turnover and attraction recirculation systems turnover.

(68) "Treatment turnover" means the minimum time necessary to circulate the entire attraction water volume through the recirculation filter system.

(69) "Trunk line" means suction piping between a junction fitting and a pump or a balancing tank.

(70) "T.U." means turbidity unit as measured by the nephelometric method.

(71) "Wading activity pool" means a pool or area less than 24 inches in total water depth with activities intended for younger children.

(72) "Walking surface" means any direct access surface to the attractions or change rooms where the user will be in bare feet. Areas set aside for picnicking, sunbathing, and lounging are excluded.

(73) "Water slide or water tube" means a sloped trough-like flume or tube structure of varying slope and direction using water as a lubricant and/or method of regulating the rider speed.

(74) "Water treatment operator" means the person appointed to operate the mechanical equipment and perform related water quality monitoring for proper operation of the physical facility.

(75) "Wave pool" means a recreational pool producing waves which usually begin at the deep end and proceed toward and dissipate at the shallow end.

(76) "WWA" means World Waterpark Association.

[Statutory Authority: RCW 70.90.120 and 43.20.050. WSR 22-07-102, § 246-262-010, filed 3/22/22, effective 4/22/22. Statutory Authority: RCW 70.90.120. WSR 12-17-102, § 246-262-010, filed 8/17/12, effective 9/17/12; WSR 10-20-131, § 246-262-010, filed 10/5/10, effective 11/5/10; WSR 92-02-020 (Order 226B), § 246-262-010, filed 12/23/91, effective 1/23/92. Statutory Authority: RCW 43.20.050. WSR 91-02-051 (Order 124B), recodified as § 246-262-010, filed 12/27/90, effective 1/31/91. Statutory Authority: RCW 70.90.120. WSR 88-13-125 (Order 311), § 248-97-020, filed 6/22/88.]

WAC 246-262-060 General design, construction, and equipment. (1) Owners shall locate RWCFs to:

(a) Minimize pollution by dust, smoke, soot, and other undesirable substances;

(b) Eliminate pollution from surrounding surface drainage; and

(c) Ensure pools within the RWCF are more than fifteen feet from any structure, object, or land formation (i.e., pumphouse, tree, etc.), which would provide a user with the opportunity to jump from such a structure into the pool. This does not include any barriers provided to prevent unauthorized access to pool or segments of attractions which enter pool.

(2) Owners shall use only materials in the structure and equipment which are nontoxic, durable, inert, impervious to water, and easily cleaned.

(3) Owners shall design and maintain walking surfaces which are:

(a) Sloped a minimum one-fourth inch per foot;

(b) Of a nonslip finish;

(c) Equipped with sufficient drains to prevent standing water;

(d) Free of resilient coverings, e.g., carpeting; and

(e) At least four feet in width.

(4) Owners shall provide adequate barrier protection to prevent unauthorized access including:

(a) In outdoor facilities, a barrier six feet or more in height with:

(i) Openings, holes, or gaps not to exceed four inches except openings protected by gates or doors; and

(ii) Lockable gates and entrances either regulated during periods of use or provided with a self-closing, self-latching mechanism a minimum of forty-two inches from the ground.

(b) In indoor facilities, suitable barriers to prevent access by unauthorized individuals or pool access by unattended small children.

(5) Owners shall ensure that pools:

(a) Comply with all provisions of chapter 246-260 WAC where pool facilities are a separate attraction;

(b) Have surfaces with:

(i) Materials complying with subsection (2) of this section;

(ii) Watertight and nonabrasive construction;

(iii) Nonslip finish where users are walking; and

(iv) White or light color finish not obscuring the view of objects or surfaces.

(c) Are dimensionally designed to provide for the safety of the user and circulation of the water including, but not limited to:

(i) Absence of protrusions, extensions, means of entanglement, or other obstruction which can cause entrapment or injury;

(ii) Construction tolerances conforming with current ANSI public pool standards;

(iii) Uniform pool floor slopes as follows:

(A) Not exceeding one foot of drop in seven feet of run for pools serving as landing or exiting pools, where total water depth is less than forty-eight inches; and

(B) Providing a maximum slope of one foot of drop in twelve feet of run up to a depth of five and one-half feet in pools where users enter and participate in extended activities.

(iv) Vertical walls for a minimum distance noted in Table 4 of this section, which may be curved (not to exceed allowable radius) to join the floor.

(A) Vertical means walls not greater than eleven degrees from plumb.

(B) Coving or portion of the side wall of a diving area in the pool shall conform as described in subsection (5)(c)(vi) of this section.

(C) In new construction or alterations to existing construction, ledges are prohibited.

(D) Requirements in subsection (5)(c) of this section do not apply to spas.

(v) A maximum intrusion beyond the vertical (as defined in subsection (5)(c)(iv)(A) of this section) with any configuration not to exceed a transitional radius from wall to floor where floor slopes join walls and which:

(A) Has its center of radius no less than the minimum vertical depth specified in Table 4 of this section below the water level;

(B) Has arc of radius tangent to the wall; and

(C) Has a maximum radius of coving (or any intrusion into the pool wall/floor interface) determined by subtracting the vertical wall depth from the total pool depth.

TABLE 4
MAXIMUM RADIUS COVING OR POOL INTRUSION DIMENSIONS BETWEEN POOL FLOOR AND WALL*

Pool Depth	2'0"	2'6"	3'0"	3'6"	4'0"	4'6"	5'0"	>5'0"
Minimum Slide Wall Vertical Depth	1'6"	1'10"	2'2"	2'6"	2'10"	3'2"	3'6"	>3'6"
Maximum Radius of Curvature	6"	8"	10"	12"	1'2"	1'4"	1'6"	**Maximum radius equals pool depth minus the vertical wall depth

Note: * For pool depths which fall between the depths listed, values can be interpolated.

** Radius of coving cannot intrude into pool within diving envelope or deep water entry area for attractions entering above pool water level.

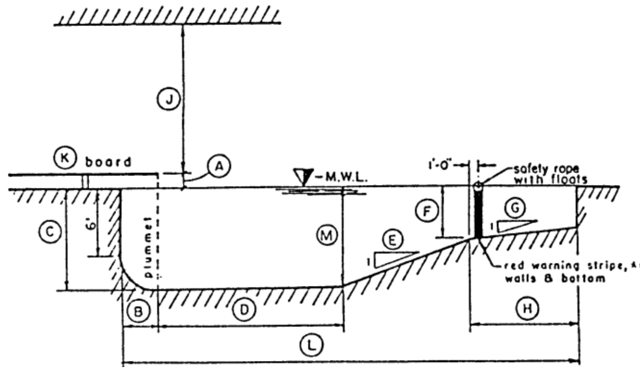
(vi) Provision of diving envelopes in pools or areas of pools designated for diving activities to include:

(A) A diving envelope of no less than the CNCA standard configuration* noted in Figure 1 of this section in areas where user would enter from deck level, diving board, or platform at a height of less than one-half meter (twenty inches).

Note: * This requirement is based on a standard described in CNCA publication "Swimming Pools: a Guide to their Planning, Design, and Operation" 1987. Fourth edition. Human Kinetics Publisher, Inc., Champaign, Illinois. Figure 8.1

FIGURE 1:

Minimum dimensions for pools with provision for diving from deck level or providing boards or platforms at a height less than one-half meter.



Dimension		Minimum	Preferred or Maximum
A	Height of board above water		20 in.
B	Board overhang	2 ft 6in.	3 ft
C	Depth of water at plummet	9 ft	10 ft*
D	Distance from plummet to start of upslope	16 ft	18 ft*
E	Inclination of upslope of bottom		1:3
F	Depth of water at breakpoint	4 ft 6 in.	
G	Slope of bottom in shallow portion of pool	1:12	1:15*
H	Length of shallow section of pool	8 ft	14 ft*
I	Distance to any overhead structure	13 ft	15 ft*
K	Board length		12 ft
L	Length of pool	40 ft	50 ft*
M	Dimension not less than C minus	6 in.	

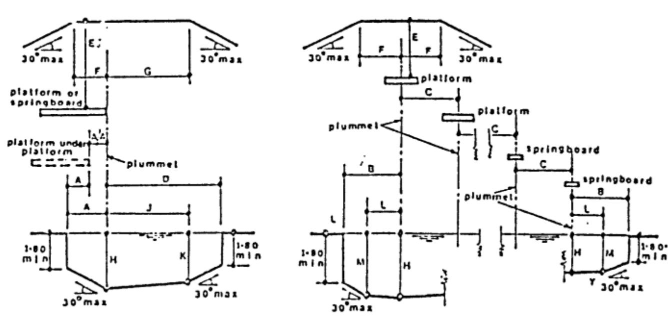
Note: * Values with asterisks are not to be considered as maximums.
** Warning stripe at break point may be of any contrasting color.

(B) A diving envelope of no less than the FINA standard configuration** noted in Figure 2 of this section in areas where user would enter from diving board or platform at a height of one-half meter (twenty inches) or greater.

Note: ** This requirement is based on a standard described in FINA publication "FINA Handbook - 1986-1988." Constitution and rules governing swimming, diving, water polo, and synchronized swimming, 1986-1988. Edited by E. Allen Harvey, Vancouver, Canada VGN 3R6, Section D, pp. 114-115.

FIGURE 2:

Minimum dimensions for pools with boards or platforms at a height of one-half meter or more.



LONGITUDINAL SECTION DIAGRAMMATIC ONLY

CROSS SECTION DIAGRAMMATIC ONLY

	Dimensions	SPRINGBOARD		PLATFORM				
FINA	are in Metres	1 Metre	3 Metres	1 Metres	3 Metres	5 Metres	7.5 Metres	10 Metres
DIMENSIONS FOR	LENGTH	4.80	4.80	4.50	5.00	6.00	6.00	6.00

	Dimensions	SPRINGBOARD				PLATFORM									
FINA	are in Metres	1 Metre		3 Metres		1 Metres		3 Metres		5 Metres		7.5 Metres		10 Metres	
DIVING FACILITIES	WIDTH	0.50		0.50		0.60		1.50		1.50		1.50		2.00	
Revised to 1st Jan 1987	HEIGHT	1.00		3.00		0.60-1.00		2.60-3.00		5.00		7.50		10.00	
		HORIZ	VERT	HORIZ	VERT	HORIZ	VERT	HORIZ	VERT	HORIZ	VERT	HORIZ	VERT	HORIZ	VERT
A From plummet BACK TO POOL WALL	DESIGNATION	A-1		A-3		A-1P1		A-3P1		A-5		A-7.5		A.10	
	MINIMUM	1.80		1.80		0.75		1.25		1.25		1.50		1.50	
A/A From plummet BACK TO PLATFORM Plummet directly below	DESIGNATION									AA5/1		AA7.5/3/1		AA10/5/3/1	
	MINIMUM									1.50		1.50		1.50	
B From plummet to POOL WALL AT SIDE	DESIGNATION	B-1		B-3		B-1p1		B-3p1		B-5		B-7.5		B-10	
	MINIMUM	2.50		3.50		2.30		2.90		4.25		4.50		5.25	
C From plummet to ADJACENT PLUMMET	DESIGNATION	C-1/1		C-3/3/1		C-1/1p1		C-3/1P1/3p1		C-5/3/1		C-7.5/5/3/1		C-10/7.5/5/3.	
	MINIMUM	2.40		2.60		1.65		2.10		2.50		2.50		2.75	
D From plummet to POOL WALL AHEAD	DESIGNATION	D-1		D-3		D-1p1		D-3p1		D-5		D-7.5		D-10	
	MINIMUM	9.00		10.25		8.00		9.50		10.25		11.00		13.50	
E On plummet, from BOARD TO CEILING	DESIGNATION		E-1		E-3		E-1p1		E-3p1		E-5		E-7.5		E-10
	MINIMUM		5.00		5.00		3.50		3.50		3.50		3.50		5.00
F CLEAR OVERHEAD behind and each side of plummet	DESIGNATION	F-1	E-1	F-3	E-3	F-1p1	E-1p1	F-3p1	E-3p1	F-5	E-5	F-7.5	E-7.5	F-10	E-10
	MINIMUM	2.50	5.00	2.50	5.00	2.75	3.50	2.75	3.50	2.75	3.50	2.75	3.50	2.75	5.00
G CLEAR OVERHEAD ahead of plummet	DESIGNATION	C-1	E-1	C-3	E-3	G-1p1	E-1p1	G-3p1	E-3p1	G-5	E-5	G-7.5	E-7.5	G-10	E-10
	MINIMUM	5.00	5.00	5.00	5.00	5.00	3.50	5.00	3.50	5.00	3.50	5.00	3.50	6.00	5.00
H DEPTH OF WATER at plummet	DESIGNATION		H-1		H-3		H-1p1		H-3p1		H-5		H-7.5		H-10
	MINIMUM		3.50		3.80		3.30		3.60		3.80		4.50		5.00
J DISTANCE AND DEPTH	DESIGNATION	J-1	K-1	J-3	K-3	J-1p1	K-1p1	J-3p1	K-3p1	J-5	K-5	J-7.5	K-7.5	J-10	K-10
K ahead of plummet	MINIMUM	5.00	3.40	6.00	3.70	5.00	3.20	6.00	3.50	6.00	3.70	8.00	4.40	11.00	4.75
L DISTANCE AND DEPTH	DESIGNATION	L-1	M-1	L-3	M-3	L-1p1	M-1p1	L-3p1	M-3p1	L-5	M-5	L-7.5	M-7.5	L-10	M-10
M each side of plummet	MINIMUM	1.50	3.40	2.00	3.70	1.40	3.20	1.80	3.50	4.25	3.70	4.50	4.40	5.25	4.75
N MAXIMUM SLOPE TO REDUCE DIMENSIONS beyond full requirements	POOL DEPTH CEILING HT	30 degrees 30 degrees		NOTE Dimensions C (plummet to adjacent plummet) apply for Platform with widths as detailed. For wider Platforms increase C by half the additional width(s)											

(d) Have adequate handholds around the perimeter in pools designed for extended swimming and bathing activity and excluding wave pools; and

(e) Stairs, ladders, or stepholes with:

(i) Stairs, when provided, meeting the following construction requirements:

(A) Treads of a nonslip finish;

(B) Stair tread edges colored to contrast with the color of the pool and clearly visible to the users;

(C) Recessed in pool areas used for lap swimming or provided with wave action; and

(D) Equipped with handrails extending over the edge of the deck.

(ii) Ladders or stepholes which:

(A) Furnish exit from pools greater than four feet in depth except in landing pools bringing the user toward a shallow area after entering the water;

(B) Are spaced a minimum of one for every fifty feet of pool perimeter greater than four feet deep;

(C) Are provided at both sides of the deep end in pools over thirty feet in width; and

(D) Are equipped with a handrail at the top of both sides extending over the coping or edge of the deck.

(iii) User access at the shallow end of pool.

(6) Owners shall ensure treatment turnover at rates no less than designated as follows:

(a) In receiving pools for water slides, water tubes, inner tube rides, speed slides or tubes, drop slides or tubes, and kiddie flume slides, treatment turnover time can be based on any of the following:

(i) Total attraction volume in one-hour period;

(ii) Treatment turnover equals design peak usage (maximum users per hour) expressed in gpm;

(iii) A rate of one hour for 20,000 gallons per two or less attraction segments. Treatment turnover times may increase proportionately for larger pool volumes per two or less attraction segments;

(iv) Alternative methods where provisions to reduce contaminants are justified to the satisfaction of the department or local health officer; and

(v) Treatment turnover times not to exceed six hours.

(b) For wave pools, a minimum treatment turnover time of two hours; and

(c) For activity pools, a minimum treatment turnover time of four hours.

(7) Owners shall provide pool inlets which are:

(a) Submerged and located to produce uniform circulation of water and chemicals throughout the pool; and

(b) Located on the bottoms of pools greater than two thousand five hundred square feet, unless otherwise justified by the engineer to the satisfaction of the department or local health officer.

(8) Except as provided in (d) and (e) of this subsection owners shall provide pool outlets with:

(a) Overflow and main drain systems with each designed to carry one hundred percent of total recirculation filter flow;

(b) Overflow outlets that have:

(i) Design to maintain a minimum of sixty percent of filter recirculation flow at all times;

(ii) An overflow channel on the pool perimeter to promote uniform circulation and skimming action of the upper water layer for pools greater than twenty-five hundred square feet, with:

(A) Design preventing matter entering channel from returning to the pool;

(B) Dimensions minimizing the hazard for bathers, such as catching arms or feet in an overflow channel;

(C) 0.01 foot slope per foot or more;

(D) Drains sufficiently spaced and sized to collect and remove overflow water to return line to filter where applicable;

(E) Size sufficient to carry one hundred percent of the recirculation flow plus the surge flow equivalent to one-fifth of the balancing tank expressed in gallons per minute.

(iii) Skimmers, when used on pools up to twenty-five hundred square feet, if:

(A) Demonstrated to operate properly under design conditions;

(B) Turbulence is not expected to interfere with operation;

(C) Maximum flow rate through skimmers does not exceed four gpm per inch of weir;

(D) Devices are recessed in the wall of the pool so that no part protrudes beyond the plane of the wall into the pool;

(E) The skimmer is equipped with a device to prevent air lock in the recirculation suction line (i.e., an equalizer line). If equalizer lines are used they must be protected with suction outlets that conform to the suction fitting standard; and

(F) The skimmer is equipped with a removable and cleanable screen designed to trap large solids.

(iv) Sidewall channels, when used on pools up to twenty-five hundred square feet, which accept the total recirculation volume of the pool through the upper side of the pool if:

(A) Overall flow through the channel exceeds four times the treatment recirculation rate;

(B) Design of channel prevents entrapment of the user;

(C) Openings of any screens have less than one-half inch slots;

(D) Channel openings do not allow access beyond the pool, except with the use of specific tools requiring their opening;

(E) Open area of screens prevent a suction or entrapment hazard which could be dangerous to the user; and

(F) The channel provides an action pulling water from the top of the pool to remove floatable debris and oils.

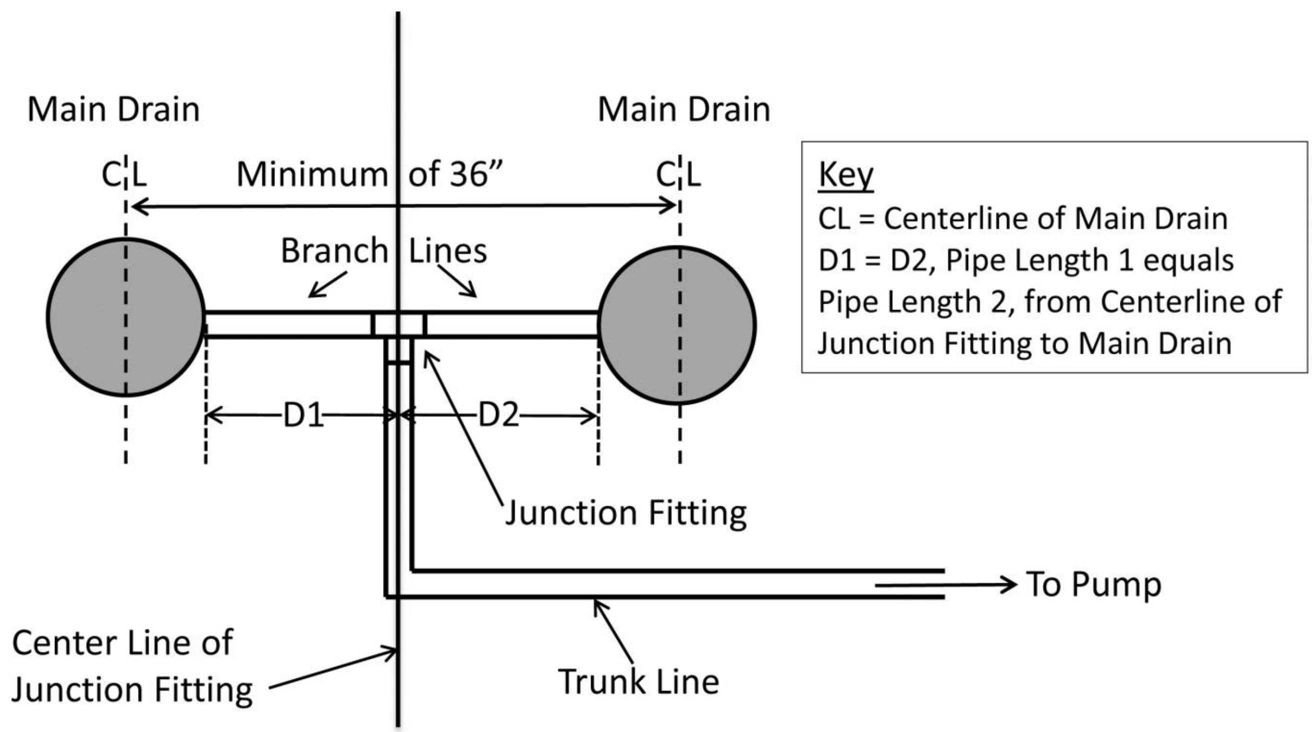
(c) Main drains in all pools must:

(i) Be located at the low points of the pool;

(ii) Have piping that is manifolded with junction fittings placed in the middle of branch line piping between main drains, so that the length of branch line piping is equal on each side of the junction fitting; see Figure 3

FIGURE 3:

Main Drain Branch Line Piping Detail.



(iii) Have a minimum of two main drains spaced at least three feet apart, measured between the centers of the drain covers;

(iv) Conform to the suction fitting standard;

(v) Have covers with a maximum flow of 1.5 feet per second;

(vi) Be designed so that if one main drain becomes blocked, the remaining main drains are rated to at least one hundred percent of the maximum pump flow; see Table 5

(vii) Have means to control flow from recirculation pump or balancing tank.

TABLE 5
MAIN DRAIN FLOW RATING REQUIREMENTS

	Number of Main Drains Per Recirculation System			
	2	3	4	5
Main drain rated flow capacity must be at least equal to the percent of maximum pump flow indicated, depending on the number of main drains.	100%	50%	33.3%	25%

(d) Existing recreational water contact facilities may be modified to operate without main drains, provided that water quality and water clarity standards established in WAC 246-262-050 are met;

(e) New recreational water contact facilities may be constructed without main drains, provided that water quality and water clarity standards established in WAC 246-262-050 are met.

(9) Owners shall maintain recirculation flow which:

(a) Does not exceed six feet per second in suction or valved discharge side of pump; and

(b) Does not exceed ten feet per second in open discharge pipes on the pressure side of the pump or filter discharge. This limit does not apply to the return inlet and the last two feet of pipe leading to the inlet.

(10) Owners shall provide a surge chamber or surge area in RWCFs with an entry pool to:

(a) Accommodate at least two minutes of the total turnover; and

(b) Maintain proper water levels for treatment and operation of the attraction.

(11) Owners having RWCFs with overflow channels requiring balancing tanks shall:

(a) Maintain volume equivalent to fifteen times maximum bathing load expressed in gallons; and

(b) Increase capacity as necessary to provide volume for make-up water and to prevent air lock in the pump suction line.

(12) Owners shall have and maintain recirculation pumps with adequate capacity to:

(a) Provide design flows and pressure for recirculation of the RWCF water over the entire operating pressure of the filter;

(b) Allow proper capacity for backwashing of filters when specified; and

(c) Have self-priming capability when installed above the pool water level.

(13) Where pumps precede the filter, owners shall install hair and lint strainers, which shall:

(a) Be located upstream of recirculation pumps;

(b) Be of corrosion-resistant material sufficiently strong to prevent collapse when clogged;

(c) Have an operable cover; and

(d) Provide valving to isolate the strainer when located below pool water level.

(14) Owners shall provide valves at appropriate locations to allow isolation and maintenance of equipment.

(15) Owners shall provide equipment rooms which:

(a) Enclose pumps, disinfection equipment, filters, and other electrical and mechanical equipment and associated chemicals;

(b) Provide adequate working space and access to perform routine operations;

(c) Provide lighting and ventilation of the equipment room; and

(d) Are not accessible to the public.

(16) Owners shall ensure the source of make-up water and associated piping in the RWCF:

(a) Provides sufficient quantity to replace daily losses from the pool;

(b) Comes from a supply conforming with chapter 246-290 WAC; and

(c) Prevents cross-connections using a minimum air gap of two pipe diameters or approved backflow prevention devices between the make-up water source and the RWCF attraction water or waste water.

(17) Owners shall equip RWCFs with filtration equipment which:

(a) Meets the applicable standards of NSF or equivalent;

(b) Uses acceptable types and filter rates described in Table 6 of this section:

TABLE 6
FILTER TYPES AND ACCEPTABLE RATES

Type of Filter	Range of Acceptable Filter Rate Expressed in gpm/sq. ft. Minimum		Maximum*
Sand			
Rapid & pressure	—		3
Pressure high rate	10		18
Vacuum high rate	10		18
DE	Continuous feed	Manual feed	
Vacuum	0.8	1.0	2.0
Pressure	1.0	1.35	2.0
Cartridge**			
Applied in temperature ranges:			
<95°F.	—		0.375
>95°F.	—		0.188

Note: * Filters sized at maximum application rate shall use flow control valves.

** Cartridge filters shall have a nominal micron rating of twenty microns or less.

(c) Has pressure or vacuum gauges for measuring loss of head (pressure) through the filter with minimum of one gauge preceding and one gauge following the filter;

(d) Has a flow indicator to measure treatment turnover; and

(e) Has means of discharging filter backwash to waste with:

(i) Discharge in a manner not creating a public nuisance;

(ii) Disposal in accordance with applicable local law or regulation;

(iii) Minimum air gap of two pipe diameters to prevent cross-connection from waste discharge and recirculation system piping;

(iv) Discharge receptor and piping of sufficient size to accept backwash water and prevent flooding; and

(v) Provisions to monitor filter effluent during backwash.

(18) Owners shall provide disinfection equipment which:

(a) Provides a continuous and effective residual of disinfectant in the water;

(b) Uses a disinfectant with a residual that is easily monitored;

(c) Conforms with NSF standards when liquid or solid feed materials are used;

(d) Has a design feed rate which will provide effective disinfection levels when RWCFs are in use;

(e) Meets the following conditions if chlorine gas is used:

(i) Chlorine rooms shall:

(A) Be above ground level;

(B) Be constructed so all openings or partitions with adjoining rooms are sealed;

(C) Be located with consideration of prevailing winds to dissipate leaked chlorine away from the RWCF;

(D) Have door opening outward only and to the out-of-doors.

(ii) Mechanical exhaust ventilation of the chlorine room including:

(A) Air inlet located as far as possible from fan intake to promote good air circulation patterns;

(B) Minimum of one air change per minute in the chlorine room when fan is operating;

(C) A remote switch outside the room or a door-activated switch to turn on fan prior to entering;

(D) Suction for fan near the floor; and

(E) Exhaust for fan and chlorinator vent located to prevent contaminating air intakes or prevent undue hazard for the users of the RWCF.

(iii) Gas chlorine systems which:

(A) Are vacuum injection type, with vacuum actuated cylinder regulators; and

(B) Provide adequate-sized backflow and anti-siphon protection at the ejector.

(iv) Breathing protection available in an accessible area for the operator outside of the chlorine room including:

(A) Instructions about limitations with chlorine concentrations and concentrations of oxygen if chlorine-type canister masks are used; and

(B) Self-contained breathing apparatus designed for use in a chlorine atmosphere as preferred equipment for working with chlorine leaks.

(v) Means for automatic shutoff when the recirculation filter pump is off or flow to the pool is interrupted;

(vi) Chlorine gas cylinders shall:

(A) Be stored only in chlorine rooms; and

(B) Not exceed one hundred fifty pounds tare weight per cylinder; except, wave pools, where one-ton cylinders may be used. Only a single, one-ton cylinder shall be stored on the premise at any time.

(19) Owners applying chemicals other than disinfectant shall provide chemical feed equipment with:

(a) Adequate size and design to allow routine cleaning and maintenance;

(b) Materials resistant to action of the chemicals to be used; and

(c) Means for automatic shut off when the recirculation filter pump is off or flow to the pool is interrupted.

(20) Owners shall have testing equipment to provide means for measuring disinfectant residuals, pH, alkalinity, and any other chemicals used routinely in the RWCF water. In pools where compressed chlorine gas is used, means to detect leaks shall be provided, i.e., use of proper strength ammonia vapor.

(21) Owners shall provide easily accessible change room facilities at all RWCFs with:

(a) Dressing rooms, showers, toilets, urinals, and sinks;

(b) Change room design including:

(i) Separate facilities for both sexes;

(ii) Floors of a nonslip finish with suitable drains;

(iii) Junctions between walls and floors coved for ease of cleaning;

(iv) Adequate ventilation to prevent build-up of moisture in the facility; and

(v) Provisions to minimize cross traffic with nonusers.

(c) Plumbing fixtures as described in Table 7 of this section.

TABLE 7
MINIMUM PLUMBING FIXTURE REQUIREMENTS
BASED ON MAXIMUM PEAK PERIOD OCCUPANCY

	Type of Fixture	Occupancy/Sex	Number of Fixtures Required Per Occupancy Load: Male	Female
1.	Toilets	First 600	1/200	1/100
		Portion exceeding 600	1/450	1/300
2.	Urinals	First 600	1/200	-
		Portion exceeding 600	1/450	-
3.	Showers	First 300	1/100	1/100
		Portion exceeding 300	1/200	1/200
4.	Sinks	First 400	1/200	1/200
		Next 350	1/350	1/350
		Portion exceeding 750	1/500	1/500
5.	Hose bibs		1 accessible to change rooms	
6.	Janitor sink		1 within the RWCF	

(d) Showers:

(i) Delivering water at a temperature range between ninety and one hundred ten degrees Fahrenheit; and

(ii) Providing liquid or powdered soap in nonglass dispensers.

(e) Flush toilets and toilet tissue in dispensers;

(f) Sinks providing:

(i) Tempered or hot and cold running water,

(ii) Liquid or powdered soap in nonglass dispensers, and

(iii) Disposable towels or electric hand dryers.

(g) Sewage disposed of in a manner approved by the department or local health officer; and

(h) Hose bibs with vacuum breakers provided at convenient locations.

(22) Owners shall design and maintain lighting at RWCF attractions or change rooms to:

(a) Illuminate indoor attractions, outdoor attractions used after dusk, or change rooms with a minimum lighting intensity maintained thirty inches above any walking surface, pool deck, or pool area of:

(i) Thirty foot-candles at indoor facilities;
(ii) Fifteen foot-candles at outdoor facilities; or
(iii) Twenty foot-candles in change rooms.
(b) Allow lifeguards or attendants to clearly see every part of pool waters and walking surfaces; and
(c) Meet any additional lighting requirements deemed necessary by the department or local health officer.
(23) Owners shall provide first-aid facilities in every RWCF including:
(a) A twenty-four package first-aid kit per WAC 296-24-065;
(b) Two or more blankets reserved for emergency use;
(c) A telephone with a prominently displayed list of emergency medical service response numbers;
(d) A backboard meeting the specifications of the ARC; and
(e) Sufficient and suitable area to accommodate persons requiring treatment and necessary first-aid equipment.
(24) Owners shall provide signs at RWCF entrances and change rooms. Any combination of words, pictures, or symbols may be used to convey the following conditions:
(a) Prohibition of use by persons with communicable diseases;
(b) Prohibition of use by persons under the influence of alcohol or drugs;
(c) Requirement for a cleansing shower before entering the attractions;
(d) Warning that persons refusing to obey the attendants are subject to removal from the premises; and
(e) Prohibition of food and drink in pool, change room, or on walking surfaces.
(25) If owners allow or make provision for food service:
(a) Food and beverage sale and consumption areas shall be separate from pool, change room, and walking surfaces;
(b) Trash containers shall be provided; and
(c) No glass containers shall be allowed in the RWCF.
(26) Owners shall prevent users or spectators access to mechanical, electrical, or chemical equipment facilities.
(27) Owners shall provide an operable drinking fountain of the angle jet type design meeting the requirements of the American Standards Association.

[Statutory Authority: RCW 70.90.120. WSR 12-17-102, § 246-262-060, filed 8/17/12, effective 9/17/12; WSR 10-20-131, § 246-262-060, filed 10/5/10, effective 11/5/10; WSR 92-02-020 (Order 226B), § 246-262-060, filed 12/23/91, effective 1/23/92. Statutory Authority: RCW 43.20.050. WSR 91-02-051 (Order 124B), recodified as § 246-262-060, filed 12/27/90, effective 1/31/91. Statutory Authority: RCW 70.90.120. WSR 88-13-125 (Order 311), § 248-97-070, filed 6/22/88.]

Date: October 8, 2024

To: Washington State Board of Health Members

From: Kate Dean, Board Member

Subject: Rules Briefing – Group A Public Water Supplies, WAC 246-290-315(8) PFAS Emergency Rulemaking – Possible Action

Background and Summary:

RCW 43.20.030(2)(a) grants the State Board of Health (Board) authority to adopt rules for Group A public water systems that are necessary to assure safe and reliable drinking water and to protect public health.

In October 2021 the Board adopted drinking water state action levels (SALs) for per- and polyfluoroalkyl substances (PFAS) in chapter 246-290 WAC, Group A Public Water Supplies and related provisions in chapter 246-390 WAC, Drinking Water Laboratory Certification and Data Reporting. WAC 246-290-315 includes criteria for monitoring, reporting, follow-up actions, and public notification relevant to SALs.

On June 12, 2024, the Board adopted emergency rules to correct criteria in the rule that apply when the Environmental Protection Agency (EPA) adopts a federal maximum contaminant level (MCL) for a contaminant that has a state action level set in rule. Before the change, WAC 246-290-315(8) said that upon *adoption* of a federal MCL, the MCL will supersede a SAL, and the associated requirements, including for monitoring and public notice.

The emergency rulemaking, filed as WSR 24-14-016, changed this to state that *when a federal MCL becomes effective,* the MCL will supersede a SAL and its requirements. This change ensures that the protections Washington currently has in place for the SALs remain in place until the federal MCLs become effective in April 2029. Emergency rules remain in effect for 120 days, and the emergency rule expires later this month.

Today, Shay Bauman, Board Policy Advisor, will brief the Board on the impacts of the emergency rule and provide a recommendation.

Recommended Board Actions:

The Board may wish to consider and amend, if necessary, the following motions:

The Board directs staff to do the following:

- File a CR-103E to initiate rulemaking for WAC 246-290-315, to continue to clearly maintain the SALs and associated requirements until the federal standards are effective.

(continued on the next page)

Staff
Shay Bauman, Policy Advisor

To request this document in an alternate format or a different language, please contact the Washington State Board of Health at 360-236-4110 or by email at wsboh@sboh.wa.gov. TTY users can dial 711.

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360-236-4110 • wsboh@sboh.wa.gov • sboh.wa.gov

WAC 256-290-315(8) – PFAS Emergency Rulemaking

Shay Bauman, Policy Advisor – October 8, 2024

WASHINGTON STATE BOARD OF HEALTH

General Project Update

Emergency Rulemaking
- Effective for 120 days
- Expires end of the month
- Positive results

Permanent Rulemaking
- Scoped the project
- Environmental Justice Assessment scoping
- Filing soon

Abbreviated Rulemaking
- Section-by-section review

Government Agency Panel – November Meeting

Question for Board Members

What specific topics related to PFAS efforts at the state level would you like to learn more about?

WAC 246-290-315(8)

Upon federal adoption of an MCL, the federal MCL will supersede a SAL or a less stringent state MCL, and the associated requirements, including for monitoring and public notice. If the federally adopted MCL is less stringent than a SAL or state MCL, the Board may take one of the following actions:

(a) Adopt the federal MCL; or

(b) Adopt a state MCL, at least as stringent as the federal MCL, using the process in subsections (6) and (7) of this section.

EPA Effective Dates

Effective June 25, 2024

Analytical requirements*

Effective April 26, 2027

Consumer Confidence Reporting*

Ongoing compliance monitoring*

Reporting and recordkeeping*

Initial monitoring results reporting

Public notification for testing and procedure violations

Effective April 26, 2029

PFAS MCL Violations

MCL Compliance Requirements

30-day Public Notification for MCL violations*

Recommendation: Initiate Emergency Rulemaking to Continue to Clearly Maintain the SALs and Associated Requirements

~~Upon federal adoption of an MCL, the federal~~ When a federal MCL becomes effective, the MCL will supersede a SAL or a less stringent state MCL, and the associated requirements, including for monitoring and public notice. If the federally adopted MCL is less stringent than a SAL or state MCL, the board may take one of the following actions:

(a) Adopt the federal MCL; or

(b) Adopt a state MCL, at least as stringent as the federal MCL, using the process in subsections (6) and (7) of this section.

THANK YOU

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ACCESSIBILITY AND THE AMERICANS WITH DISABILITIES ACT (ADA)

- The Washington State Board of Health (Board) is committed to providing information and services that are accessible to people with disabilities. We provide reasonable accommodations, and strive to make all our meetings, programs, and activities accessible to all persons, regardless of ability, in accordance with all relevant state and federal laws.
- Our agency, website, and online services follow the Americans with Disabilities (ADA) standards, Section 508 of the Rehabilitation Act of 1973, Washington State Policy 188, and Web Content Accessibility Guidelines (WCAG) 2.0, level AA. We regularly monitor for compliance and invite our users to submit a request if they need additional assistance or would like to notify us of issues to improve accessibility.
- We are committed to providing access to all individuals visiting our agency website, including persons with disabilities. If you cannot access content on our website because of a disability, have questions about content accessibility or would like to report problems accessing information on our website, please call (360) 236-4110 or email wsboh@sboh.wa.gov and describe the following details in your message:
    - The nature of the accessibility needs
    - The URL (web address) of the content you would like to access
    - Your contact information

We will make every effort to provide you the information requested and correct any compliance issues on our website.

WSR 24-14-016
EMERGENCY RULES
STATE BOARD OF HEALTH
[Filed June 24, 2024, 12:54 p.m., effective June 24, 2024, 12:54 p.m.]

Effective Date of Rule: Immediately upon filing.

Purpose: Testing of drinking water contaminates; state action levels (SALs) and state maximum contaminant levels (MCLs) in WAC 246-290-315.

The state board of health (board) has authority under RCW 43.20.050 to adopt rules for group A public water systems that are necessary to ensure safe and reliable public drinking water and to protect the public health. Chapter 246-290 WAC, Group A public water supplies, establishes standards and requirements for these water systems. The department of health (department) administers the rules.

To ensure safe drinking water, water must be tested for contaminants. The board establishes SALs and MCLs to ensure contaminate levels are below a certain threshold. The board sets criteria for the adoption of SALs and MCLs in WAC 246-290-315, and includes criteria that would apply upon federal adoption of MCLs. WAC 246-290-315(8) states that upon federal adoption of an MCL, the MCL will supersede a less stringent SAL and associated requirements, including monitoring and public notice.

The Environmental Protection Agency published new federal standards for per- and polyfluoroalkyl substances (PFAS) on April 10, 2024, with an adoption date of June 25, 2024. These new standards include MCLs. This affects the board's rule and triggers the provision in WAC 246-290-315(8). The federal standards, however, have delayed effective dates for criteria and public health protections that are currently in place for Washington. According to the Washington state rules associated with the SALs, public water systems must notify customers of detections of PFAS above the SAL within 30 days of that detection. This is necessary to allow people the opportunity to protect themselves by using bottled water, securing a filter, or taking other measures. Thirty-day public notification is not effective for MCLs in the federal standard until April 2029. Without this amendment to WAC 246-290-315, customers served by group A public water systems will no longer be notified of dangerous levels of PFAS in their drinking water, which is a significant reduction in protections.

The board adopted an emergency rule on June 12, 2024, to amend WAC 246-290-315 such that the criteria would apply on the effective date of an MCL as set in the federal standard, not the adoption date, in order to maintain vital public health protections for drinking water safety. Along with the emergency rule making, the board initiated a permanent rule making to amend the rule language to align with the emergency provision and explore other protections.

Citation of Rules Affected by this Order: Amending WAC 246-290-315.

Statutory Authority for Adoption: RCW 43.20.050 (2)(a).

Under RCW 34.05.350 the agency for good cause finds that immediate adoption, amendment, or repeal of a rule is necessary for the preservation of the public health, safety, or general welfare, and that observing the time requirements of notice and opportunity to comment upon adoption of a permanent rule would be contrary to the public interest.

Reasons for this Finding: The federal adoption date of the standards is June 25, 2024, at which point the MCLs and relative protections will supersede the SALs. Because of the delayed effective date, currently active public health protections will end on that date. The board finds that emergency adoption of this rule is necessary to preserve public health.

Number of Sections Adopted in Order to Comply with Federal Statute: New 0, Amended 0, Repealed 0; Federal Rules or Standards: New 0, Amended 0, Repealed 0; or Recently Enacted State Statutes: New 0, Amended 0, Repealed 0.

Number of Sections Adopted at the Request of a Nongovernmental Entity: New 0, Amended 0, Repealed 0.

Number of Sections Adopted on the Agency's own Initiative: New 0, Amended 1, Repealed 0.

Number of Sections Adopted in Order to Clarify, Streamline, or Reform Agency Procedures: New 0, Amended 0, Repealed 0.

Number of Sections Adopted using Negotiated Rule Making: New 0, Amended 0, Repealed 0; Pilot Rule Making: New 0, Amended 0, Repealed 0; or Other Alternative Rule Making: New 0, Amended 1, Repealed 0.

Date Adopted: June 24, 2024.

Michelle A. Davis, MPA
Executive Director

OTS-5531.1

AMENDATORY SECTION (Amending WSR 21-23-097, filed 11/17/21, effective 1/1/22)

WAC 246-290-315 State action levels (SALs) and state maximum contaminant levels (MCLs). (1) The department shall consider the following criteria to select a contaminant for developing a SAL:

(a) Drinking water contributes to human exposure to the contaminant.

(b) The contaminant is known or likely to occur in public water systems at levels of public health concern. Sources of occurrence information include, but are not limited to:

(i) Washington state department of agriculture;

(ii) Washington state department of ecology; and

(iii) Monitoring results reported in accordance with 40 C.F.R. 141.35.

(c) The contaminant has a possible adverse effect on the health of persons exposed based on peer-reviewed scientific literature or government publications, such as:

(i) An EPA health assessment such as an Integrated Risk Information System assessment;

(ii) Agency for Toxic Substances and Disease Registry toxicological profiles;

(iii) State government science assessment; and

(iv) EPA guidelines for exposure assessment such as the EPA exposure factors handbook.

(d) A certified drinking water lab can accurately and precisely measure the concentration of the contaminant in drinking water at and below the level of public health concern using EPA-approved analytical methods.

(2) After consideration of the criteria in subsection (1) of this section, the department may develop a SAL based on the following:

(a) Evaluation of available peer-reviewed scientific literature and government publications on fate, transport, exposure, toxicity and health impacts of the contaminant and relevant metabolites;

(b) An assessment based on the most sensitive adverse effect deemed relevant to humans and considering susceptibility and unique exposures of the most sensitive subgroup such as pregnant women, fetuses, young children, or overburdened and underserved communities; and

(c) Technical limitations to achieving the SAL such as insufficient analytical detection limit achievable at certified drinking water laboratories.

(3) The state board of health shall consider the department's findings under subsections (1) and (2) of this section when considering adopting a SAL under this chapter.

(4) Contaminants with a SAL.

(a) If a SAL under Table 9 of this section is exceeded, the purveyor shall take follow-up action as required under WAC 246-290-320. For contaminants where the SAL exceedance is determined based upon an RAA, the RAA will be calculated consistent with other organic contaminants per WAC 246-290-320(6) or other inorganic contaminants per WAC 246-290-320(3).

TABLE 9
STATE ACTION LEVELS

Contaminant or Group of Contaminants	SAL	SAL Exceedance Based On:
Per- and polyfluoroalkyl substances (PFAS)		
PFOA	10 ng/L	Confirmed detection
PFOS	15 ng/L	Confirmed detection
PFHxS	65 ng/L	Confirmed detection
PFNA	9 ng/L	Confirmed detection
PFBS	345 ng/L	Confirmed detection

(b) If a system fails to collect and submit a confirmation sample to a certified lab within ten business days of notification of the sample results, or as required by the department, the results of the original sample will be used to determine compliance with the SAL.

(5) The department shall consider the following when developing a state MCL:

(a) The criteria in subsection (1) of this section;

(b) Whether regulating the contaminant presents a meaningful opportunity to reduce exposures of public health concern for persons served by public water systems;

(c) The need for an enforceable limit to achieve uniform public health protection in Group A public water systems; and

(d) The need for an enforceable limit to support source water investigation and clean-up of a contaminant in drinking water supplies by responsible parties.

(6) In addition to the requirements in subsection (5) of this section, the department shall:

(a) Meet the requirements of subsection (2) of this section;

(b) Comply with the requirements in RCW 70A.130.010 to establish standards for chemical contaminants in drinking water;

(c) Consider the best available treatment technologies and affordability taking into consideration the costs to small water systems; and

(d) Determine that the probable benefits of the rule are greater than its probable costs, taking into account both the qualitative and quantitative benefits and costs.

(7) The state board of health shall consider the department's findings under subsections (5) and (6) of this section and follow the requirements under chapters 34.05 and 19.85 RCW when adopting a state MCL under this chapter.

(8) ((~~Upon federal adoption of an MCL~~)) When a federal MCL takes effect, the federal MCL will supersede a SAL or a less stringent state MCL, and the associated requirements, including for monitoring and public notice. If the federally adopted MCL is less stringent than a SAL or state MCL, the board may take one of the following actions:

(a) Adopt the federal MCL; or

(b) Adopt a state MCL, at least as stringent as the federal MCL, using the process in subsections (6) and (7) of this section.

Washington State Board of Health
Policy & Procedure

Policy Number:	**2001-001**
Subject:	**Monitoring and Communicating With the Legislature About Legislation Relevant to the State Board of Health**
Approved Date:	**January 10, 2001 (Revised June 13, 2012)**

Policy Statement

The Washington State Board of Health monitors and communicates with the Legislature on proposed legislation that:

- Has a direct impact on the Board's statutory powers and duties;
- Runs counter to the Board's intent or direction as stated in existing rule;
- Is directly related to priorities established by the Board each biennium, supported by a Board-approved strategic plan, work plan, interim document, or final report;
- Is directly related to a policy issue addressed in the Board's "Statement on Likely Legislative Issues."
- May adversely impact the public health system.

Procedure

Prior to each legislative session, Board staff, under the direction of the Executive Director, will identify policy issues that are likely to come before the Legislature that have any bearing on the Board's broad statutory authority, its rule making activities, or its priorities. The Executive Director will present a list of these issues to the Board for discussion at a meeting prior to legislative session. The Board may choose to adopt a "Statement on Likely Legislative Issues" that reflects the Board's position on those issues.

During legislative session, Board staff will routinely review legislative bill introductions, committee agendas, and monitor legislative meetings. The Executive Director will provide regular legislative updates to Board members, which may include: upcoming hearings or work sessions, staff activities, bill summaries and recommendations, and budget information.

Action on Bills of Interest

Board staff, in consultation with the Executive Director, shall prepare a summary of concerns, draft messages, and suggested technical solutions for the Chair's approval that Board members or staff may use to communicate the Board's position to a bill's sponsor, appropriate committee chairs, other legislators, and legislative staff.

The Executive Director and the Board Chair or his or her designee must review and approve all correspondence to legislators and legislative staff that conveys the Board's position on legislation or other issues before the Legislature. The correspondence should routinely be copied and sent to the Office of the Secretary – Policy, Legislative, and Constituent Relations.

Responsibility for Communicating with the Legislature
The Board Chair may recommend a specific amendment or other action on proposed legislation to legislators or legislative staff on behalf of the Board, if the Chair believes the position is generally consistent with the wishes of the majority of the Board. The Executive Director or Board staff may transmit or deliver these communications for the Chair.

A Board member may communicate his or her views on Board letterhead and may ask Board staff to help communicate his or her views only if the communication is consistent with Board position and this policy.

This policy is not intended to prevent a Board member from communicating with the Legislature on proposed legislation or other matters of personal interest to the member. However, in these cases, the Board member must clarify that his or her communications do not necessarily reflect the views of the Board and that he or she is acting on his or her own personal behalf.

Agency Request Legislation
Board staff must prepare agency request legislation according to Office of Financial Management (OFM) guidelines and schedules. The Executive Director shall work closely with other state agencies to assure the bill does not conflict with other agency authorities. Consistent with OFM guidelines, all agency request legislation must receive Governor's approval before the Executive Director may seek sponsors or promote the bill to legislators.

Recommendations to the Governor
If the Legislature passes a bill that the Board has testified on or sought amendments to, Board staff, in consultation with the Executive Director and Board Chair, may develop a recommendation to the Governor to sign, partially veto, or veto the legislation. The memo must briefly describe the bill, the Board's position, and recommend Governor's action (sign, partial veto, or veto). Prior to submitting a memo to the Governor's office, staff must complete an enrolled bill analysis for the Governor's executive policy analyst assigned to the legislation.

PDC Reporting
Any Board or staff member who has in-person contact with legislators or legislative staff, including in meetings and at hearings, regarding legislation on behalf of the Board must report the activity to the Executive Director. This report must include the date of the communication, length of time spent with the individual(s), and the topic of discussion, including bill numbers. The Executive Director may need to include these reports in the Board's consolidated quarterly lobbying report as required by the Public Disclosure Commission under RCW 42.17A.635.

Statement of the Board on Possible Legislative Issues 2023-2025 Biennium

It is the policy (Policy 01-001) of the Washington State Board of Health (Board) to comment on legislative proposals that affect the Board's:

- Statutory authority and rules,
- 2022 State Health Report Recommendations, and
- 2017-2022 strategic plan activities

This statement represents the Sense of the Board and is used to guide staff and Board members in their communications on legislative and budget proposals. The statement is not intended to be an exhaustive list of anticipated legislative topics but is focused on priority issues.

Foundational Public Health Services

The Board believes that *Public Health is Essential* and supports the recommendations developed by the Foundational Public Health Services (FPHS) Policy Workgroup to modernize the public health system and provide state funding to the governmental public health system for the delivery of FPHS, so services are available in every community. The governmental public health system must be able to monitor health, focus on prevention, assure health for all, and be capable of an all-hazards response. Providing ongoing sustained resources to the governmental health system is critical in order to address inequities, innovate, and modernize. This includes increasing the Board's capacity to meet its statutory obligations under chapter 43.20 RCW and other state laws.

The Board believes it is critical for the state to provide adequate, dedicated, stable funding for full implementation of FPHS statewide that keeps pace with inflation and demand for services. The Board supports continuation of FPHS funding to the governmental public health system. The Board **opposes** reductions to funding for the governmental public health system, including changes in fee authority or reductions to funding sources such as the Model Toxics Control Act.

Local Health Officer Authority

Washington's COVID-19 pandemic response has shown the critical importance of assuring our public health partners have evidence-based knowledge and resources to quickly identify and respond to disease outbreaks and other health threats. Much of the ability to respond to outbreaks and other public health threats in communities falls under the local health officer's authority. The local health officer is appointed by a county's local board of health. Local boards of health, local health administrators, and officers have a statutory duty to carry out the state's public health laws and rules. Public health response should not be partisan or politicized. The Board **opposes** legislation that diminishes local health officer duties or authorities.

Advancing Health Justice and Equity in State Government

The Board recognizes that racism is a public health crisis and is embedded within the health care delivery and public health system. Racism and other forms of discrimination have been and continue to be institutionalized and perpetuated through policies and practices that prevent meaningful community engagement and limit opportunity and access to important public services. Health inequities cannot be eliminated without addressing structural and institutional racism in these systems. The Board supports legislation that is anti-racist and prioritizes and operationalizes health justice and equity across state government.

The Board supports the Governor's Interagency Council on Health Disparities' (Council's) efforts to use a health justice framework to advance enduring health equity and social justice. Health justice centers the following principles: racial equity; collaboration across areas of study and work; upstream interventions that address root causes of inequities and injustice; adaptability; advocacy for systems change; and community-based strategies that uphold community power. Since 2006, the Council has heard from its advisory committees and members of the public, particularly communities most impacted by inequities, that the state needs to address structural and institutional inequities in our state system as a key strategy for eliminating health inequities. Therefore, the Board supports the Council's legislative proposal to update the Council's name, membership, duties, and authority in RCW 43.20 and related laws. The Board also supports the Council's decision package for increased, ongoing funding (General Funds-State) in the state's operating budget. These funds would support the Council's operations; enable enhancement of community/partner engagement, communications, and collaboration; and provide language assistance services and community compensation.

The Board supports systemic efforts to remove barriers to participation and promote inclusion and civic participation for historically marginalized communities and communities most impacted by policy decisions. One recent example includes legislation (2SSB 5793 – Chapter 245, Laws of 2022) allowing state agencies to compensate community members with lived experience or low income for participating in certain workgroups or Technical Advisory Committees. The Board supports proposals that improve mechanisms and resources for compensating community members and organizations for their time, effort, and expertise so they can participate. The Board also supports proposals that improve coordination and resources for language assistance services, so community members can better access resources, including public health services, and participate in policy development.

The Board recognizes that interaction with Tribes, as sovereign nations, and Tribal members requires processes and resources that are unique and distinct from community engagement. The Board supports proposals that would remove barriers and enhance resources/mechanisms for compensation of Tribal participation in Washington state government policy development and other efforts (e.g., honoraria).

Through a proviso in the 2019-2021 operating budget, the Legislature directed the Council to convene an Office of Equity Task Force to develop an operations plan for a future Washington State Office of Equity. In 2020, the Board endorsed the Task Force's recommendations as well as legislation that created the Washington State Office of Equity. The Board supports legislative proposals that align with the Task Force's recommendations, including proposals that assure ongoing and adequate funding for the Office of Equity.

Data Disaggregation

Disaggregated data can reveal inequities across and within groups and are instrumental for public health efforts to prevent and control diseases and conditions. However, demographic data collection in Washington is currently decentralized and inconsistent, as agencies often must work within the parameters of outdated federal data standards. Collecting data in greater detail is essential to identifying and eliminating health inequities, undoing institutional racism, and advancing equity within public health and the broader governmental system.

Collecting and analyzing disaggregated data helps the governmental public health system identify and address health inequities and can help policy makers prioritize resources for communities. The COVID-19 pandemic shed light on the systemic and structural inequities in the healthcare and public health systems. Collection and use of disaggregated data was, and continues to be, vital to identifying impacted populations. Together, disaggregated data and qualitative data—stories from disproportionately impacted communities—support effective public health responses, including partnering with communities on outreach, prevention, and access to care. Without these data, the public health system cannot effectively and equitably respond to a public health crisis.

The National Academies released recommendations to improve health equity in federal policy-making, including recommendations related to advancing data sovereignty and disaggregating race/ethnicity data. The Board supports legislation that aligns with these federal recommendations and legislative action to ensure the collection of disaggregated race/ethnicity and language data, beyond Census-level categories. The Board also supports the collection of data variables that help in identifying and eliminating health inequities. Examples of these types of variables include but are not limited to housing status, Veteran status, sexual orientation, gender, gender identity, occupation, income, and disability status. If collected transparently, consistently, and through individual self-report, these variables can provide insight into the social determinants of health and equity while respecting an individual's autonomy. The Board also supports legislation that improves how data link up and work together across public health and health care systems, to enable more meaningful collection, analysis, and use of these data.

Health and wellness of people who are pregnant or postpartum and their children

The Board supports enhancing systems and support for people who are pregnant or postpartum, infants, and children, and the monitoring of mortality due to pregnancy-related conditions. The Board recognizes that institutional racism contributes to high rates of preventable pregnancy-related deaths, and barriers to accessing reproductive and perinatal health care in Washington.

In alignment with this recognition, the Board supports recommendations in the Department of Health's 2023 Maternal Mortality Review Panel Report (MMRP), and Healthy Pregnancy Advisory Committee Report on Strategies for Improving Maternal and Infant Health Outcomes. The Board also supports the Tribal and Urban Indian Leadership recommendations from the American Indian Health Commission (AIHC) addendum in the MMRP report, which underscore the importance of Tribally led and informed solutions to maternal and pregnant person health.

Additionally, the Board supports recommendations in the Council's Literature Review on Inequities in Reproductive Health Access, as required by SSB 6219 (2018). The Board also supports the Council's position (adopted September 2022) to use a Reproductive Justice framework when considering and addressing inequities in access to reproductive health care services. A Reproductive Justice framework expands beyond personal choice, focusing on access to services and emphasizing the autonomous right to have children, not have children, and raise the children we have in safe and sustainable communities. The Board shares the Council's commitment to understanding how racialized power systems limit access to health and opportunity and commits to centering racial justice in our work and consideration of proposed legislation.

Newborn Screening

The Board has the authority to define and adopt rules for newborn screening in Washington. The rules include the list of conditions the Department of Health's Newborn Screening program must screen all newborns for. If the Board adds a new condition, the Department must assess the programmatic and fiscal impacts to the current program. The Washington Health Care Authority's Medicaid Program covers about forty percent of births in Washington. The addition of new conditions may require the Department and Health Care Authority to request an increase in the newborn screening fee to cover the costs of new screening tests, staff time and follow-up services for babies with positive screens, and other programmatic and administrative costs. The Board supports funding requests to increase the newborn screening fee to cover the costs associated with new conditions.

Healthy Environment for All (HEAL) Act

The Board agrees with the Environmental Justice (EJ) Task Force's statement that "Washington cannot achieve equity without [environmental justice]" and that "[t]he pathway to reaching an equitable Washington is only possible through ongoing anti-racism, environmental conservation, public health, and community engagement work." In 2021, the Legislature passed the Healthy Environment for All (HEAL) Act. The HEAL

Act created the Environmental Justice Council and created obligations for seven state agencies to integrate environmental justice into agency decision-making, policy, and practice, as well as specific provisions to update and maintain the Washington Tracking Network's Environmental Health Disparities Map. Other agencies may opt-in to the obligations. Three agencies, including the Board, have opted to join in a "Listen and Learn" capacity and are participating in meetings of the Environmental Justice Council and implementing HEAL Act requirements as resources allow. The Board supports ongoing and increased funding to support implementation of the HEAL Act and additional environmental justice efforts across state agencies, including the Environmental Justice Council's decision package for increased funding to support the EJ Council's operations.

Health Impact Reviews

Under RCW 43.20.285 the Board conducts Health Impact Reviews (HIRs) at the request of the Governor or a legislator. HIRs are objective, non-partisan, evidence-based analyses of proposed legislative or budgetary changes to determine the potential impacts on health and equity. The Board receives funding for 1.6 FTE through the Foundational Public Health Services budget, which contributes 2.6 FTE total to conduct HIRs. HIRs improve the state's ability to use evidence to inform policy and to promote health and equity. While the Board supports additional state and legislative efforts to assess equity impacts of legislative proposals, the Board recognizes the unique value that HIRs add to legislative decision-making. The rigorous HIR research approach, which uses both quantitative and qualitative research, as well as lived experience, provides legislators with a nuanced understanding of how proposed policy may impact the status quo and health and equity in the state. The Board supports the retention of HIRs and will continue to offer assistance and support to ensure any new proposed tools align with and do not duplicate the work of HIRs.

The Board supports legislative action to ensure long-term, sustainable solutions to obtain peer-reviewed literature access for HIR work. The Board believes that there is also a need for all state entities (agencies, boards, commissions, councils, etc.) to have access to research and published literature to inform evidence-based policy and program development.

School Environmental Health and Safety

The Board believes that all children should be able to attend schools that are built, maintained, and operated to ensure a safe and healthy environment. The Board supports removal or amendment of the budget proviso that suspends the Board's rules related to environmental health and safety standards for primary and secondary schools (Chapter 246-366A WAC). Until the Board's suspended school rules can be implemented, the Board supports the Department of Health's November 2016 recommendations in response to the Governor's directive on lead as they relate to school environmental health and safety.

The Board has long recognized that ongoing, regular inspections and technical assistance provided by local health jurisdictions are critical to ensuring schools are designed, built, and maintained to protect students' health. Only eighteen of Washington's thirty-five local health jurisdictions have school environmental health and safety programs. In order to provide basic health and safety protections for all school children across the state, local health jurisdictions must have sufficient resources and capacity to conduct school environmental health and safety inspections.

Indoor air quality is a key component of a healthy school environment. Higher ventilation rates can improve absenteeism and student performance, as well as reduce transmission and spread of respiratory illness, including SARS-CoV-2 (the virus that causes COVID-19). Indoor air quality can also be adversely impacted by increased wildfire and extreme weather events. Regular inspection, maintenance, and repairs of heating, ventilation, and air conditioning (HVAC) systems, as well as adequate ventilation to dilute contaminants, can improve indoor air quality and school safety.

The Board supports the Environment Justice Council's 2024 Climate Commitment Act funding recommendations that relate to school environmental justice, as well as proposals to adequately fund school repair and remediation strategies to improve school environmental health and safety, and legislation to assess, improve, and update ventilation systems and other infrastructure strategies to improve health, safety, and indoor air quality in school facilities.

On-Site Sewage Systems

The Board recognizes that on-site sewage systems are an important and effective means of treating and dispersing effluent if the systems are properly permitted, sited, operated, and maintained. The Board supports legislation that preserves the authority of local health officers and boards of health to develop and implement on-site sewage system regulations and plans which protect public health and meet community needs. The Board supports efforts to assure local on-site site sewage management programs have adequate capacity and funding, including assessment of local septage handling and capacity.

Food Safety

The Board recognizes that food service is evolving. The COVID-19 pandemic has, and continues to have, major impacts on food service and has prompted creative ideas to improve food access and equitable entry into the restaurant industry. This session, the Board anticipates legislation on topics including microenterprise or commercial kitchens, community pantries and/or refrigerators, foods offered in bed and breakfast settings, and regulations of non-permanent structures. The Board's support of food service-related legislation depends on whether the proposal includes critical public health safeguards that uphold essential food safety standards (including but not limited to permitting, inspections, plan review, time to temperature controls, and other public health measures).

The Board would oppose legislation that would exempt currently unregulated practices such as microenterprise home kitchens from fundamental environmental health and safety requirements for food service facilities.

Aquatic and Water Recreation Facilities

The Board recognizes that drowning is the leading cause of death for children ages 1-4 years and a significant source of morbidity in children under 19 years. State and local regulations on aquatic facilities, water recreation facilities, and designated swim areas are necessary and important to protect the health, safety, and welfare of those who use them. The Board supports legislation that aims to prevent injury, illness, and death at facilities such as swimming pools, hot tubs, splash pads, water parks, natural designated swim areas, and more.

Shellfish Sanitation

The Board recognizes that sanitary controls are essential for the safe production, harvest, processing, and marketing of shellfish. Historically, the Board's rulemaking authority and the Department of Health's regulatory authority have focused on the commercial and recreational harvest of bivalve molluscan shellfish such as clams, oysters, mussels, and geoduck. The Board supports legislation that preserves and strengthens sanitary controls for molluscan shellfish. The Board and its partners have observed shifting needs related to climate change, marine biotoxins, and other shellfish, such as crab. In 2021, 2022, and 2023, bills were proposed, but did not pass, that would amend chapter 69.30 RCW, Sanitary Control of Shellfish. The proposed bills would allow the Board to conduct rulemaking to establish sanitary controls for commercial crab harvesting and processing and grant the Department of Health authority to regulate commercial crab as it pertains to marine biotoxins such as domoic acid and paralytic shellfish poisoning. The 2023 bill will again be considered in the 2024 Legislative Session and the Board supports its passage. The Board has completed an HIR on SHB 1010.

Drinking Water

The Board recognizes that safe, reliable drinking water systems and drinking water supplies are essential for public health protection and community wellbeing. The Board's Group A rules cover the state's largest public water systems, and its Group B rules apply to public systems that generally serve fewer than fifteen connections. The Board supports budget and policy proposals that strengthen implementation of these rules, drinking water infrastructure, and source water protection.

Governor's Directive on Lead and Childhood Lead Poisoning Prevention

Governor Inslee issued Directive 16-06 on May 2, 2016, to address lead remediation in the built environment. Environmental pathways for lead exposure include drinking water at homes, schools, and outdoor areas.

The Board continues to support the Department of Health's November 2016 report recommendations to the Governor, including continuing the initial investment made to test drinking water at schools, provide remediation funds to replace fixtures, improve remediation assistance for low-income and rental properties, and provide focused blood testing for children at greatest risk of exposure to lead and subsequent case management. The Board was pleased with the passage of E2SHB 1139 during the 2021 legislative session, which requires lead testing and remediation in school drinking water. The Board also supports:

- Updating the *Health and Safety Guide for K–12 Schools in Washington State.*
- Gathering data to evaluate and update chapter 246-366A WAC, Environmental Health and Safety Standards for Primary and Secondary Schools, including updates to align with E2SHB 1139 and recent revisions made to the federal lead and copper rules.
- Including environmental health and safety in decisions using the funding formula for school construction and modernization.
- Encouraging healthcare providers to follow DOH blood lead screening recommendations.
- Ongoing efforts to establish or improve existing data sharing agreements between the Department, Health Care Authority, and other public health agencies to access lead testing rates and related information for children enrolled in Medicaid.
- Updating the Washington State Plan Amendment (SPA) to add two new billable service areas (for home lead exposure assessments and targeted case management) and the upcoming implementation of the Interagency Agreement (IAA) to allow the Department to receive Medicaid Administrative Match.

Preventing Smoking and Vaping

In August 2016, the Board adopted Resolution 2016-01 to increase the age of purchase for tobacco and vapor products from age 18 to 21 years. During the 2019 legislative session, EHB 1074 passed, raising the legal age for purchasing tobacco and vapor products from age 18 to 21 years. While EHB 1074 was an important step to prevent youth access, Washington's Purchase Use and Possession (PUP) law needed further reform to prevent inequitable enforcement practices that negatively affect youth, specifically youth of color, and instead, shift the responsibility to commercial tobacco businesses or industry actors.

During the 2023 Legislative Session, ESSB 5365 passed, which increased monetary penalties for retailers that sell to underage youth, limited the circumstances in which youth could be detained, and modified sanctions and fines for underage youth purchase, use, or possession of commercial tobacco products. The Board supports legislation that continues to improve PUP laws in Washington and reduces inequitable enforcement.

In addition, the Board supports enhancing current strategies to prevent the marketing, sales, and use of commercial tobacco products and cannabis to youth, which may include restricting the sale of flavored vapor and tobacco products and adding additional authority for the Secretary of Health to issue product bans and recalls of smoking and vapor products. The Board supports legislation that would improve regulation of Washington's vapor product industry, including requiring vapor ingredient disclosure and routine lab testing for vapor products, requiring signage regarding health risks of these products, removing the preemption of vapor product retail licensing, allowing for product bans and recalls, and instituting nicotine limits in products sold in Washington.

In response to an outbreak of e-cigarette and vapor product-associated lung injury, the Board adopted rules to ban the use of vitamin E acetate in vapor products. Compounds, such as Delta-8 THC, and other additives, continue to emerge on the market with little known about their impacts on health. The Board supports efforts to understand and address emerging compounds that result in negative health effects.

Oral Health

The Board acknowledges that expanded access to oral health care improves health outcomes because dental care is inextricably linked to whole-body health. In 2015, the Board adopted 7 recommended oral strategies after a collaborative multi-year project to assess the oral health needs of Washingtonians. The Board supports legislation that will advance its Recommended Strategies to Improve the Oral Health of Washington Residents. In 2022, the Legislature tasked the Department with assessing oral health equity in the state (ESSB 5693), focusing on community water fluoridation. The Board supports recommendations in the Oral Health Equity Assessment report to reduce oral health inequities in Washington. In addition, the Board would support the development of a state oral health officer at the Department of Health.

Immunizations

The Board recognizes the research and data that demonstrate that immunizations reduce the incidence of vaccine-preventable disease in our community and protect those who are immunocompromised and those unable to be vaccinated. The Board supports legislation that helps reduce the number of children who are out of compliance with state immunization documentation requirements, assists schools and childcares in monitoring the immunization status of children, and increases immunization rates across all age groups. The Board supports additional funding to increase school nurse capacity and improve access to and use of the Washington State Immunization Information System.

The Board also supports the Department of Health's efforts to promote vaccination against respiratory viruses such as COVID-19 and RSV by making these vaccines accessible through the Washington Vaccine Association (WVA).

Obesity Prevention and Access to Healthy Food

The rate of increase in obesity among Washington residents has slowed compared to other states. The Board supports efforts to create equitable access to safe, well-lit public spaces that promote movement, including parks and playgrounds. The Board supports efforts to increase access to healthy foods including fresh fruits and vegetables, maintaining and expanding access to programs such as WIC, WIC/SNAP at farmers markets, USDA's school lunch program, and efforts to increase access to culturally relevant foods, reduce food insecurity, and increase opportunities for physical activity.

The Board also supports maintaining funding for the Fruit and Vegetable Incentive Program, which provides incentives to people with low incomes experiencing food insecurity to support healthy food options.

Opioids

The Board supports the goals, strategies, and actions outlined in the updated 2021-2022 Opioid and Overdose Response Plan and the forthcoming updated plan, to effectively combat the opioid epidemic. Its goals are to:

- Prevent opioid and other drug misuse.
- Identify and treat opioid misuse and stimulant use disorder.
- Ensure and improve the health and wellness of people who use opioids and other drugs
- Use data and information to detect opioid misuse, monitor health effects for persons who use drugs, analyze population health, and evaluate interventions.
- Support people in recovery.

The Board also supports recommendations from the Washington State Tribal Opioid and Fentanyl Summit. In addition, the Board supports Governor Inslee's updated budget strategy, as outlined in the 24-25 proposed supplemental budget, to expand funding for opioid and fentanyl education and awareness, health engagement hubs, low-barrier opioid treatment programs, overdose prevention efforts, and for Tribal governments to support response efforts to the opioid and fentanyl crisis in their communities.

Increase Access to Health Insurance Coverage

A number of efforts have increased access to affordable health insurance for people in Washington, including federal initiatives like the Affordable Care Act, Medicaid expansion, and American Rescue Plan Act, and state initiatives like Cascade Care. Access to health insurance increases access to and use of healthcare services and improves health outcomes. In 2021, the legislature passed supplemental legislation to further increase the affordability and availability of Cascade Care. This included a new premium and cost-sharing subsidy program administered by the state. Starting in 2023, people will be able to sign-up for health and dental plans on Washington Healthplanfinder regardless of immigration status. Despite these efforts, the average health insurance premium doubled from 2014 to 2024. State agencies and partners continue to consider policies to make healthcare more affordable in Washington State. The Board supports legislation that continues to build and sustain access to affordable health coverage across the state for all Washingtonians and legislation that alleviates cost concerns.

Mental Health Services

The Board recognizes the disparate access to consistent and culturally appropriate mental health services in the state, particularly for historically marginalized communities and communities that have been disproportionately impacted by the COVID-19 pandemic. In recent years, there have been efforts to increase access to video and audio platforms that provide mental health services. The Board supports continued efforts to increase access to these and other mental health services across our communities.

The Board also recognizes the workforce challenges that plague the mental healthcare system. New provider types such as certified peer counselors have expanded capacity for support services, but gaps still exist. Additionally, studies continually show that there are public health benefits to providers reflecting the racial/ethnic diversity of their patients, by increasing trust, participation in care, and an increase in patient comfort. The Board supports efforts to increase and diversify the mental health workforce in Washington. The COVID-19 pandemic has had a profound impact on youth and families and exacerbated the need for access to age-appropriate services, especially in schools. During the 2023 session, the legislature revised certain education, training, experience, and exam requirements for behavioral health profession licensure (2SHB 1724) to address workforce barriers and support more behavioral health professionals practicing in Washington State. The Board supports efforts to make mental health services readily available to youth in Washington and increase social and emotional supports in schools.

Additionally, the Board recognizes the impacts of historical and intergenerational trauma and the disproportionate effects it has on the mental health of Native communities. As such, the Board supports legislation related to supporting Tribal-led and informed mental health and behavioral health services in Washington. Further, in the current Washington state mental and behavioral health systems, the role of Tribal sovereignty and recognition of the Indian health system are often overlooked. The Board supports legislation to clarify the role and authority of Tribal governments to improve the Washington state behavioral health system for better coordination and recognition with the Indian behavioral health system.

WASHINGTON STATE BOARD OF HEALTH

School Environmental Health and Safety Rule Project 2024 - 2025

What: Updates to K-12 School Environmental Health and Safety Standards

The Washington State Board of Health (Board) is working to develop new proposed standards for K–12 school environmental health and safety. The Board plans to develop and propose new language to the legislature by June 2025.

Why:

The current standards are over 50 years old, and the Legislature considers them outdated. Legislative restrictions delayed updating the standards, but now the Legislature has directed the Board to propose a new school environmental health and safety rule. As part of that process the Board is inviting all interested parties (parents, teachers, administrators, the general public) to provide comments and make recommendations.

History:

Chapter 246-366[1] of the Washington Administrative Code (WAC) sets the current standards for K–12 school environmental health and safety for over one million students. In 2004, the Board initiated rulemaking to update this outdated rule and spent the next five years creating and adopting chapter 246-366A[2] WAC.

In the 2009–2011 biennium, the Legislature directed the Department of Health (Department) and the Board not to implement any new or amended rules related to these school facility standards due to concerns about cost. Every budget since 2010 has included the proviso. In response, the Board has continued to extend the effective date of Chapter 246-366A.

In 2016, Governor Inslee directed the Department to continue providing technical assistance and guidance for school districts to conduct voluntary water quality tests[3]. The Legislature previously appropriated over 7.4 million dollars to the Department and the Office of the Superintendent of Public Instruction (OSPI) to support lead testing and remediation in schools.

During the 2024 legislative session, the Legislature included funds for the Board to review chapter 246-366 and 246-366A WACs and to propose updated environmental health and safety standards for K–12 schools in Washington state.

[1] https://apps.leg.wa.gov/WAC/default.aspx?cite=246-366&full=true&pdf=true
[2] https://apps.leg.wa.gov/wac/default.aspx?cite=246-366A&full=true&pdf=true
[3] https://governor.wa.gov/sites/default/files/directive/dir_16-06.pdf

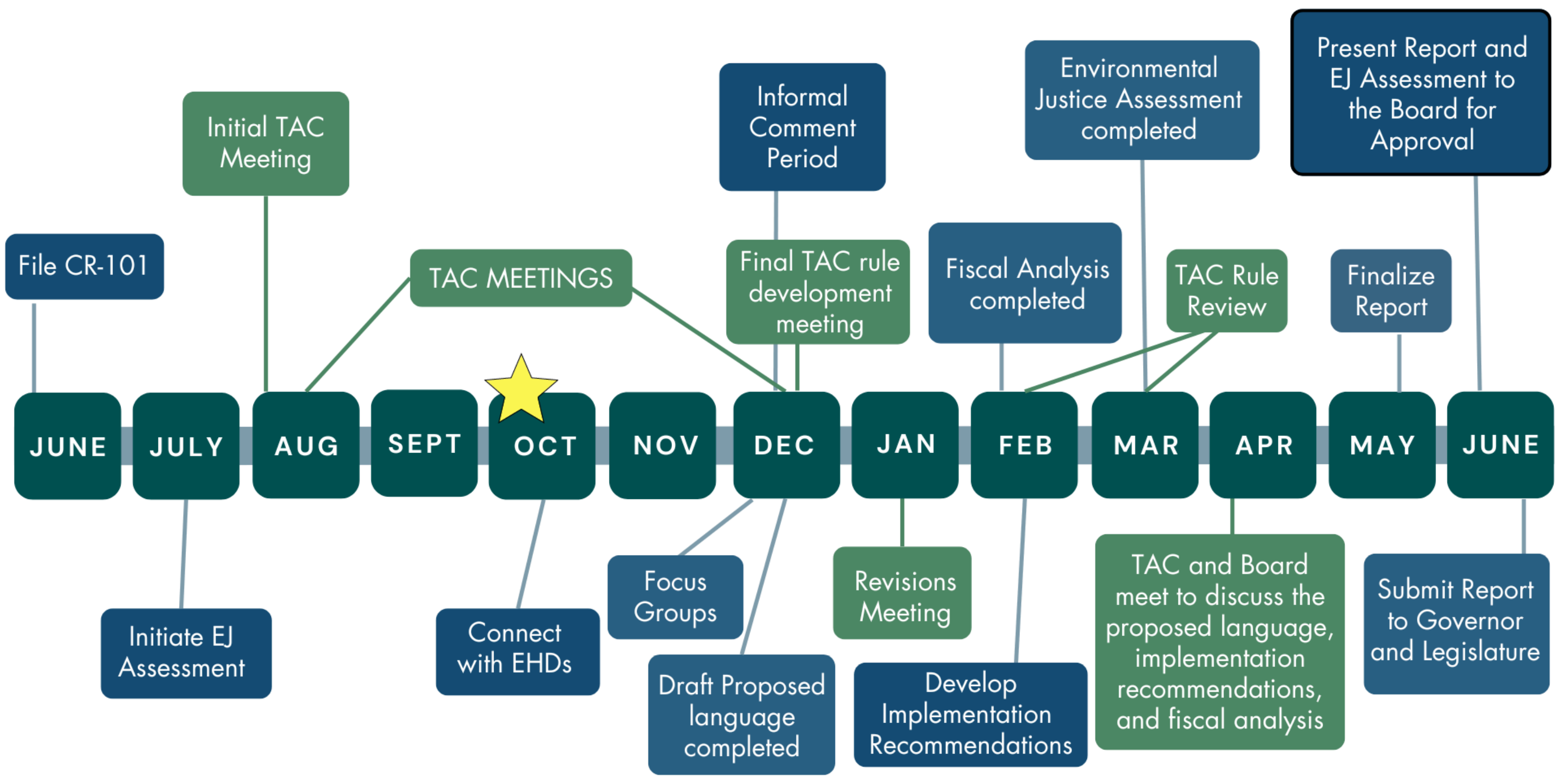
WASHINGTON STATE BOARD OF HEALTH

School Environmental Health and Safety Rule Project 2024 - 2025

The Legislature directed the Board to:

- Convene a technical advisory committee (TAC) consisting of various school associations, school districts, and OSPI to propose updated requirements.
- Collaborate with OSPI to develop a fiscal analysis.
- Assist the Department in completing an environmental justice assessment[4] on any proposed rule.
- Work with the Department, OSPI, the TAC, and local health jurisdictions to provide a report to the Office of the Governor and appropriate committees of the Legislature by June 30, 2025.

Visual Timeline:



[4] https://doh.wa.gov/community-and-environment/health-equity/environmental-justice/assessments

WASHINGTON STATE BOARD OF HEALTH

School Environmental Health and Safety Rule Project

Yakima Valley, we want your input!

We all want our children to be safe and healthy at school. Help us establish **new rules for environmental health and safety**, covering areas like testing water quality, air quality, and playground safety.

The Washington State Board of Health is working on these new standards, which will apply to all public and private K-12 schools.

We invite community members, families, teachers, and school staff to be part of this process and to share their comments and suggestions. Your input will help us create the best rules possible for all our children!

Please participate and provide recommendations!

School Environmental Health and Safety Rule Project
Listening Session

Date: **October 10, 2024**
Time: **6:00 - 8:00 p.m.**
Location: **Union Gap School, Multi-purpose Room**
3201 4th St.
Union Gap, WA 98903

- ASL and Spanish interpreters will be available.
- Children and students are welcome.
- Snacks will be available.

Receive notifications!
Subscribe at School Rule Project Interest Form
by scanning the QR code below:

This event is NOT sponsored by the Yakima School District, and the district assumes no responsibility for the conduct at, or safety of, the event. In consideration for the privilege to distribute these materials, the school district shall be held harmless from any cause of action, claim, or petition filed in any court or administrative tribunal arising out of the distribution of these materials, including all costs, attorney's fees, and judgments or awards, claims, liabilities, damages, expenses, or right of action, directly or indirectly attributed to the activities. Permission to distribute this flyer should not be considered a recommendation of the program by the school district. This is not a school district-sponsored activity.

Date: October 8, 2024

To: Washington State Board of Health Members

From: Kelly Oshiro, Board Member

Subject: 2024 Newborn Screening Criteria Review Project

Background and Summary:

The Washington State Board of Health (Board) has the authority under RCW 70.83.050 to adopt rules for screening Washington-born infants for hereditary conditions. WAC 246-650-010 defines the conditions, and WAC 246-650-020 lists the conditions on the state's required newborn screening panel.

The Board has a process it follows when considering new conditions to include in the state's newborn screening panel. To determine which conditions to include, the Board may convene an advisory committee to evaluate candidate conditions using guiding principles and an established set of criteria.

Since 2023, the Board has received four petitions for rulemaking to evaluate new conditions for possible inclusion in the state's mandatory newborn screening panel. Last legislative session, the Board also received a directive to review two additional conditions: branch-chain keto acid dehydrogenase kinase deficiency (BCKDKD) and congenital cytomegalovirus (cCMV).

Advancements in screening technology and rare disease treatments may lead to a further increase in requests, along with seven candidate conditions that the Department of Health is monitoring for potential review. To address the increase in condition review requests and anticipated workload, the Board's current process and criteria may need to be reviewed and updated. The current process and criteria were last reviewed in 2014- 2015.

The Board and Department of Health are forming a technical advisory committee (TAC) to identify possible strategies to streamline the condition review request process, modernize the evaluation criteria, and strengthen the overall process to address current demands better. This same TAC will also complete condition reviews for BCKDKD, cCMV, and Wilson's Disease. The first TAC to review process and criteria is scheduled for October 28, 2024, at the Public Health Lab in Shoreline, WA.

Recommended Board Actions:

This is an informational update, not requiring any Board action.

Staff

Kelly Kramer, Policy Advisor

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TTY users can dial 711.

Newborn Screening (NBS) Updates

- TAC #1: Scheduled October 28, 2024
  - TAC membership confirmed
  - Recording a NBS Video Orientation for TAC members
  - Present TAC decisions and action items at November Board meeting
- TAC #2: BCKDKD January 2025
- TAC #3: cCMV February 2025
- Upcoming Spring/Summer 2025:
  - Wilson's Disease TAC
  - Present MPS-II again to the Board

WASHINGTON STATE BOARD OF HEALTH

Date: October 8, 2024

To: Washington State Board of Health Members

From: Patty Hayes, Board Chair

Subject: Rules Briefing—The Sanitary Control of Shellfish, chapter 246-282 WAC. This is not an action item.

Background and Summary:

The State Board of Health (Board) and the Washington Department of Health (Department) collaborate to regulate the sanitary control of molluscan shellfish. The Board serves as the rulemaking body and the Department serves as the regulatory agency. The Department also serves as the state shellfish authority administering the model ordinance of the National Shellfish Sanitation Program (NSSP).

RCW 69.30.030 authorizes the Board to adopt rules governing shellfish sanitation, shellfish growing areas, and shellfish operations to protect public health and safety. Further, RCW 43.20.050, establishes the authority to adopt rules for the prevention and control of infectious and noninfectious disease, including food and vector borne illness.

On February 23, 2022, the Board filed a CR-101, Preproposal Statement of Inquiry, as WSR 22-06-034, to initiate rulemaking to update chapter 246-282 WAC, Sanitary Control of Shellfish. The rulemaking covers miscellaneous technical revisions along with updates to WAC 246-282-006, Vibrio parahaemolyticus (Vp) Control Plan and other parts of the rule.

Board staff coordinated with the Department's Office of Environmental Health and Safety to finalize draft proposed changes and gather feedback. An informal public comment period was open from April 12, 2024, to May 24, 2024.

Today, Shay Bauman, Board Policy Advisor, will brief the Board on updates to the rulemaking's progress and next steps.

This is not an action item.

Staff

Shay Bauman, Policy Advisor

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Chapter 246-282 WAC – The Sanitary Control of Shellfish

Project Briefing

Shay Bauman, Policy Advisor – October 8, 2024

WASHINGTON STATE BOARD OF HEALTH

Rulemaking Background

- High number of Vibriosis cases in 2021, largely due to exceedingly high temperatures.
  - The Department of Health expects the trend of high temperatures to continue.
  - Highlighted gaps in the rule and demonstrated the need to explore additional protections.

- The Board delegated emergency rulemaking authority to the Department of Health if heat wave conditions occur before July 1.

Recent Activity

- Reviewed over 200 comments and suggestions from 8 interested parties
  - Categorized comments

Changes to the rule	Response Document	Need further engagement

- Drafted an engagement plan to gather further feedback from the industry
- Met with industry group representatives for feedback on the engagement plan
  - Pacific Coast Shellfish Growers Association (PCSGA)
  - Willapa-Grays Harbor Oyster Growers Association (WGHOGA)
  - Northwest Indian Fisheries Commission (pending)
- Tours

Next Steps

Engagement starting in November

- Hybrid meetings
- Issue-focused agendas so partners can prioritize time and attendance
- Separate meetings for Tribal partners tailored to their priorities, locations, and capacity
- Ensure feedback from both large and small farms

Engagement with parties regarding response to comment document

- Answer questions, clarify where needed

Additional visits

Continue to refine rule language using feedback

New NSSP Model Ordinance

THANK YOU

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ACCESSIBILITY AND THE AMERICANS WITH DISABILITIES ACT (ADA)

- The Washington State Board of Health (Board) is committed to providing information and services that are accessible to people with disabilities. We provide reasonable accommodations, and strive to make all our meetings, programs, and activities accessible to all persons, regardless of ability, in accordance with all relevant state and federal laws.
- Our agency, website, and online services follow the Americans with Disabilities (ADA) standards, Section 508 of the Rehabilitation Act of 1973, Washington State Policy 188, and Web Content Accessibility Guidelines (WCAG) 2.0, level AA. We regularly monitor for compliance and invite our users to submit a request if they need additional assistance or would like to notify us of issues to improve accessibility.
- We are committed to providing access to all individuals visiting our agency website, including persons with disabilities. If you cannot access content on our website because of a disability, have questions about content accessibility or would like to report problems accessing information on our website, please call (360) 236-4110 or email wsboh@sboh.wa.gov and describe the following details in your message:
    - The nature of the accessibility needs
    - The URL (web address) of the content you would like to access
    - Your contact information

We will make every effort to provide you the information requested and correct any compliance issues on our website.

HEALTH PROMOTION COMMITTEE SPECIAL MEETING SUMMARY NOTES

What: Health Promotion (HP) Committee

When: September 5, 2024

Attending: Board of Health (Board) Members Dimyana Abdelmalek (Committee Chair), Kelly Oshiro; Board staff Molly Dinardo, Kelly Kramer, Shay Bauman, Hannah Haag, Melanie Hisaw, Anna Burns, Heather Carawan; Department of Health (Department) staff Meghan Cichy, Leah Wainman, Chelsea Henry, John Thompson, Katy Art, Samantha Fuller; and approximately five members of the public also attended the meeting.

Summary Notes:

Rulemaking and Other Project Updates

- Molly Dinardo, Board staff, provided an update on the rules hearing for the addition of Ornithine Transcarbamylase Deficiency (OTCD), Guanidinoacetate Methyltransferase (GAMT) Deficiency, and Arginase 1 Deficiency (ARG1-D) to the newborn screening (NBS) panel (Chapter 246-650 WAC). The hearing has been postponed. Board staff aim to submit the rules package by the end of the year and have been in communication with former technical advisory committee (TAC) members and the parent advocating for the addition of these conditions.
- Molly shared that there have been some delays in progress on the Vital Statistics rulemaking delegation (Chapter 246-491 WAC) due to staff turnover. Work is picking back up. Depending on progress, Board staff may ask for an update from Department of Health (Department) staff at a future Committee or Board meeting.
- Molly discussed K-12 Auditory Screening rulemaking and the work to embed equity in our process. To enhance inclusivity, the team collaborated with a Deaf interpreter to create an American Sign Language video announcement, which is available on the Board's website. Molly also noted that staff are working on proposed rules and aim to finalize a first draft by the end of the year for circulation. Board Member and HP Committee Chair Dimyana Abdelmalek expressed enthusiasm and appreciation for this initiative.
- Molly shared progress on the 2024 State Health Report. The report is complete and planned for Spanish translation and broader distribution following the October Board meeting. Molly encouraged Board Members to share the report widely and to share any feedback with our team. Molly asked Board and Committee Members how we can build on the work done for the State Health Report. Board Vice Chair Oshiro suggested a visual shorter summary that can be shared with the community; and setting aside time at each meeting to check in

(Continued on the next page)

on progress toward the recommendations made in the report. HP Committee Chair Abdelmalek expressed appreciation for the work and for the community panelists who participated and asked about the Board's role in engaging external partners.

- Molly and Shay Bauman, Board staff, will talk with Board Members about collaboration with the Environmental Health Committee.
- Meghan Cichy, Department staff, shared updates on the exception rulemaking delegation for school immunizations (WAC 246-105-040 and 246-105-060). There will be a public rules hearing on September 18, 2024, at 1:00 p.m. on the Tumwater campus, TC2- Rm 166/167, and via Zoom. Public comments will be accepted through 11:59 PM PST on September 18. More information can be found on the Department of Health Proposed Rules Page.
- Kelly Kramer, Board staff, provided an overview and timeline of the NBS Project. Kelly is in the process of sending invitations to potential and prior TAC members. The first TAC meeting in October will focus on reviewing the process and criteria for adding screening conditions to the NBS panel. Board Members expressed interest and anticipation in the findings. Board Vice Chair (and Sponsor) Oshiro asked a question about congenital cytomegalovirus (cCMV). Kelly said there is direction to re-review it and budget discussions with the Health Care Authority.

Preview of October and November Board Meetings

- Molly shared that the next Board meeting is Tuesday, October 8, 2024, in Yakima. The meeting is co-located with the Washington State Public Health Association (WSPHA) conference. The agenda will likely include updates from Yakima Public Health, a presentation from the Department on Be Well Washington, and a discussion led by Executive Director Michelle Davis regarding the Board's 2025 legislative statement. Additional agenda items will cover updates on upcoming NBS projects, shellfish rulemaking, emergency rulemaking for per- and polyfluoroalkyl substances (PFAS), and a briefing on the Pro-Equity Anti-Racism (PEAR) plan.
- Kelly reviewed the timeline for upcoming NBS projects. HP Committee Chair Abdelmalek asked if there are ways that the Board can support the implementation of recommendations that come from the NBS TAC meetings. John Thompson, Department staff, expressed appreciation for Kelly's work and shared that the Department is hiring a Policy Analyst to bolster their ability to keep track of advances in NBS technology.

Informational Briefing: Washington State Health Assessment (SHA) and State Health Improvement Plan (SHIP)

- Leah Wainman and Chelsea Henry, Department staff, provided an overview of the Washington State's Health Assessment and Health Improvement Plan. They shared the history, health equity goals, tools, and plans associated with these collaborative processes. HP Committee Chair Abdelmalek shared appreciation for this critical work, both from a local public health and Board perspective. Leah may follow up with Dimyana directly for local health jurisdiction feedback.

Chelsea shared that there is compensation available for community members to participate.

Committee Member Comments, Questions, and Next Steps

- HP Committee Chair Abdelmalek shared reflection on today's meeting focusing on centering healthy lives - from the very beginning with Newborn Screening, to the statewide health assessments, taking all lived experience into account. Board Members and Board staff thanked everyone for participation and look forward to upcoming work.

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Memorandum of Understanding Between The Washington State Department of Health and The Washington State Board of Health

I. Introduction

The State Board of Health serves the people of Washington by working to understand and prevent disease across the entire population. Established in 1889 by the State Constitution, the Board of Health recommends strategies and promotes health goals to the Legislature and Governor and regulates a number of health activities, including drinking water, immunizations, and food handling.

The Governor appoints ten members who fill three-year terms, with the exception of the Secretary of Health, who serves at the Governor's pleasure. Local health jurisdictions are represented by a local health officer, cities and counties are each represented by an elected official. There are two consumer representatives, and four members represent health and sanitation, one of whom represents Washington's federally recognized Tribes.

The Board monitors the health of the people who live in Washington. It develops rules that protect and promote the public's health and prevent the spread of disease. The Board serves as a forum for the development of public health policy in Washington State and advises the Secretary on health policy issues pertaining to the department and the state. The Board staffs the Governor's Interagency Council on Health Disparities which is responsible for developing a state action plan to eliminate health disparities by race/ethnicity and gender. The Board conducts Health Impact Reviews in consultation with the Council, and at the request of the Governor or a state legislator. The Board's offices and staff are housed at the Washington State Department of Health, which provides technical staff and other support to the Board under RCW 43.20.030 and this agreement.

The Department of Health was established by the Legislature in 1989 under Chapter 43.70 RCW as a way to focus public health attention on programs and issues previously spread across a number of other agencies. There are four divisions within the Department of Health and nine centralized offices:

- Health Systems Quality Assurance,
- Prevention and Community Health,
- Environmental Public Health,

- Disease Control and Health Statistics,

Centralized Offices:

- Office of the Chief of Staff
  - People Services / Human Resources
  - Center for Facilities, Risk and Adjudication
  - Office of Financial Services
  - Center for Inclusion, Belonging, and Well-Being
- Office of Health and Science
- Office of Innovation and Technology
- Office of Public Affairs and Equity
- Office of Policy, Planning and Evaluation
- Office of Resilience and Health Security
- Office of the Secretary
- Office of Strategic Partnerships

II. Purpose

This MOU focuses on the administrative relationship between the Board and the Department briefly described in state law in RCW 43.20.030, "The Washington State Department of Health shall provide necessary technical staff support to the board." The purpose of the MOU is to detail how the Board and the Department will interact in this regard in order to most effectively and efficiently accomplish the missions of each agency.

III. Definitions

For the purposes of this document the following words shall have the following meanings:

"Board" means the Washington State Board of Health in Chapter 43.20 RCW.

"Department" means the Washington State Department of Health in Chapter 43.70 RCW.

"Technical staff support" means administrative support and services and includes assignment of Department employees to serve as full-time or part-time staff to the Board, who may function as content or technical experts in assisting the Board in carrying out its day-to-day functions and duties. This term also includes the staff that supports the Interagency Council on Health Disparities. The term does not include the Board's Executive Director or their Confidential Secretary, both of whom are employed by the Board.

IV. Roles

The Department will provide necessary technical staff support services to the Board consistent with RCW 43.20.030.

The Board's Executive Director is responsible for overseeing all administrative activities, policies and procedures required to ensure the Board functions effectively. The Executive Director and Board comply with applicable state and federal laws, administrative rules, policies, collective bargaining agreements, and Governor's executive orders and directives. It is noted that not all executive orders and directives apply to the Board.

The Department's Chief of Staff provides a conduit for the Executive Director to raise issues perceived above and beyond day-to-day operational issues.

The Department will maintain a liaison to the Board. The liaison will monitor all regular board meetings to identify and track major regulatory and policy issues potentially impacting agency programs or politically sensitive issues. The liaison maintains regular contact with Department management and the Executive Director and if problems are identified helps assure the appropriate individuals are engaged.

The Department's Deputy Chief of Policy will serve as a conduit for the Executive Director to access internal resources and support services. The Deputy will solicit input on and provide information about organizational and operational topics, decisions and processes that impact the Board.

When the Department or the Board develops recommendations or legislative proposals that may change the other's statutory authorities or impact their respective activities, both parties agree to provide to the other opportunities for comments on drafts as far in advance as possible. Comments will be considered in the formulation of recommendations. The Board will have full access and use of the Department's legislative, rules and policy tracking systems.

The Board participates in the agency's health equity and diversity and inclusion activities. This collaboration ensures strong communication and partnerships on initiatives and activities for the agency and the state.

The Office of Public Affairs and Equity (OPAE) will ensure that board staff are included in the planning and development of any OPAE high priority project that impacts or relies on state laws or rules that are under the Board's authority.

V. Administrative Services

The Department agrees to provide all available and necessary administrative services to the Board required for successful operation and execution of the Board's work. The Department will include a Board representative on Administrative Operations workgroups and teams that involve these types of services. The Board agrees to follow all Department policies and procedures associated with the services provided under this MOU. To assure adequate opportunity for policy review and comment, the Executive Director will serve on the Department's policy review committee.

Financial Services

The Department provides financial services to the Board, including budget preparation, contract, procurement, and accounting and payroll services.

Budget

A portion of the Department's biennial appropriation will be allocated to support the Board in fulfilling its functions, including paying the costs of the Board's two exempt employees as well as technical staff support that the Department provides to the Board. The Executive Director and the Chief Financial Officer, or designee, will meet prior to budget preparation to discuss the Board's budget needs. In addition, the Department's Budget office will:

- Assist the Executive Director and Board in the preparation of biennial and supplemental budget requests and allotments and submit these materials to the Office of Financial Management (OFM) in conjunction with the Department's submittals.
- Monitor expenditures and provide monthly status of expenditures as compared to allotments/spending plans to the Executive Director.
- For legislation impacting the Board, coordinate and finalize fiscal note submissions with written authorization by the Executive Director.
- Assist the Executive Director in developing and submitting the chart of accounts, salary projections, payroll coding changes, and other OFM or Department budgetary requirements.
- Assist the Executive Director in responding to fiscal queries from legislative or OFM staff.

Contracts

The Department will provide contract support to the Board. Contracts may provide for direct services to clients, support services, technology acquisitions, and may be in the form of interagency agreements and MOU with other state agencies, governments, Tribes, as well as software licensing and data sharing agreements. The Department's Contract Unit will:

- Provide consultation and assistance to Board staff in the development of statements of work, and competitive solicitations.
- Conduct the solicitation process to include meeting any requirements of Department of Enterprise Services (DES), negotiate terms or assist in negotiations and conditions of contracts, process and prepare contracts for signature.
- Serve as liaison with DES on contractual matters.
- On all standard and nonstandard contracts, review and provide comments/

recommendations and negotiate directly with or assist in the negotiation with contractors, for any required modifications to statement of work and contract terms and conditions.
- Maintain contractual records and documentation such as receipt and control of all contract correspondence, amendments, advertisements, DES filings, solicitation information and other documents related to the contract.
- Provide guidance on contract matters to program managers or other operational staff, as needed, including training to project managers and other employees in contracting practices and procedures.
- Ensure that signed contracts are communicated to all relevant parties to provide contract visibility and awareness, and interpretation to support implementation.
- Maintain the Enterprise Contracts Management System (ECMS) database for easy access to Board contract information.
- Serve as the point of contact for the Board on contractual matters, and act as contractual liaison between Board employees and contractors as needed.

Procurement
The Department will:

- Provide expertise in purchasing items, supplies, and services for the Board.
- Train Board staff in Department and state purchasing rules and requirements to ensure all purchasing transactions are completed properly.
- Seek the best pricing for Board following all purchasing rules.

Accounting and Payroll
The Department will:

- Assure payment of duly authorized vendor billings and contract services.
- Assure payment of duly authorized travel expenditures for Board staff and Board and Council members.
- Process bimonthly payroll and benefits for Board staff and qualifying Board members.
- Process all cash receipts/revenue received on behalf of the Board.
- Track all capital, IT, and small and attractive asset inventories for Board.

Office of Facilities

Business Services
The Department will manage services provided by DES, Consolidated Mail Services that includes the sorting and delivery of United States Postal Service and campus mail daily for the Board.

The Department will provide Board support services such as the receiving and delivery of packages processed by other shipping companies (FedEx, UPS, etc.)

The Department will provide additional Board support by maintaining an inventory of office supplies in all agency copy rooms or that can be shipped to remote workers, as well as access to the INVERS Fleet Vehicles.

Building Management

The Department will furnish the facilities and services needed for the Board staff to use in a manner equal to those afforded Department employees, including conference and meeting rooms and motor pool vehicles.

Workplace Safety

The Department will provide the same workplace safety and building security services to the Board staff in the same manner as afforded to Department employees. In addition, the Board will have a role in the Continuity of Operations Plan (COOP) efforts that will ensure preparedness for inward facing emergencies.

The Board will have a seat at the Strategic Facilities Group and will follow the Department's processes and procedures in using any facilities, equipment or services.

Records Management & Public Records Disclosure

The Department will serve as primary records custodian for records created in the course of providing administrative support (HR, IT, Financial, etc.) to the Board. In the event of the dissolution of this MOU, both the Department and Board will jointly review such records to determine what records would be required to remain under the custody of the Department, and what records would be appropriately transferred to the Board or other designated entity. The Department will:

- Assist the Board with the creation and maintenance of a records retention schedule, including presenting any recommended changes to the State Records Committee for approval as appropriate.
- Assist the Board, upon request, with any requirements (activities or paperwork for the transfer of records to the State Records Center, the State Archives or the Digital Archives, and disposition of records that have met their retention period.
- Ensure the Board Executive Director is informed of training opportunities in the areas of Records Management and Public Records Disclosure so that Board staff may participate as appropriate.
- Ensure the Board Executive Director is informed of any initiatives or changes in the areas of Records Management or Public Records Disclosure that could significantly impact the Board.
- Provide administrative support, upon request, for large-scale public records requests.
- Notify the Board of public records requests submitted to the Department, if the request pertains to a topic for which the Department and Board have shared work.

- Assist the Board with scanning requests, using the Department's Centralized Scanning Unit on the designated fee-for-service basis

The Board will respond to requests for public records, submitted to the Board, independently of the Department; however, the Department will assist the Board in searching for responsive records that are in electronic form residing on the Department's network systems.

The Board and Department will notify one another of public records requests, that to topics for which the Department and Board have shared work.

Center for Facilities, Risk, and Adjudication

The Department will process claims for damages against the Board and its employees. This will include, on the Board's behalf, interaction with the state risk manager, claim settlement, arrangement for defense counsel, and coordination with assistant attorneys general from that agency's tort division. The Department's Office of Enterprise Risk Management will consult with the Board Executive Director upon receipt of a claim, and at every major step until the claim is resolved. The Department will not authorize settlement of a claim against the Board for more than five thousand dollars without approval of the Executive Director.

The Board is included in the Department's tort liability coverage provided through the self-insurance liability fund (Chapter 4.92 RCW). The Department may assess the Board a proportionate share of its liability insurance premium as if the Board were a sub-division of the Department. The Board's share may only be based on number of employees and/or its claims history.

In support of the Department's Title VI/Limited English proficiency Non-Discrimination Policy, Equal Access for Individuals with Disabilities Policy, and Language Access Plan, the Center for Facilities, Risk, and Adjudication (CRFA) and the Office of Public Affairs and Equity (OPAE) have joint responsibility for assisting Title VI/ADA Liaisons. The Executive Director shall appoint a Title VI/ADA Liaison. The Department will provide technical assistance and resources to assist the Board with implementing the Department's Language Access Plan and to be compliant with the Equal Access for Individuals with Disabilities Policy, including access to the CTS Language Link telephonic interpreter services line and access to any resources set aside for document/web/video/publication translation or ADA compliance.

The Department may provide assistance and training on the Ethics in Public Service Act to the Board and Board staff. The Department will provide assistance and training on the Ethics in Public Service Act (RCW 42.52) to the Board and Board staff upon request.

Emergency Preparedness

The Department will include the Board and its staff in campus emergency response plans and Board staff will participate in emergency response drills. The Board is encouraged to provide a representative to the safety and emergency response committee.

The Board shall complete and update as necessary a continuity of operations plan under the guidance of the Department's emergency preparedness staff. In case of emergency, and resulting unavailability of Board staff, per this agreement and the Board's Continuity of Operations Plan, the execution of the State Board of Health's essential functions will devolve to the Department.

The Information Service Office (ISO) will provide the Board with data sharing consultations, and vendor acquisition consultations to ensure compliance with state and federal requirements. The Department will also facilitate or conduct information asset risk and security assessments.

ISO will also provide security administration for Secure File Transfers (SFT) and tokens for remote access, conduct security assessments of new and existing technology solutions used for increasing the value of the services provided by the Board, conduct assessments of business processes used to distribute information and provide assistance with investigating suspected data breaches, unauthorized disclosures and potential information loss.

Audit

The Department will provide internal control and advisory services, external audit liaison services.

The Department's professional internal control and advisory services provide independent and objective assessments and assurances on the effectiveness of operations, controls, systems, and processes affecting the Board. The Board may request specific audit or advisory services through the Chief of Staff.

The Department's External Audit team also serves as liaison with external auditors, including the State Auditor's Office, JLARC, and federal regulators. The Department will provide liaison services for any audit or investigation by the State Auditor's Office affecting the Board. The Department will provide liaison services for other external audits or investigations affecting the Board upon request.

In addition, the Department's external audit manager is the designated official for maintaining the Department's Whistleblower Policy. Any Board member or staff member with questions about the Whistleblower policy can reach out to the external audit manager.

Performance and Accountability

The Department will:

- Provide expertise and technical assistance in performance management, quality improvement and strategic planning to the Board.
- Include Board staff in trainings on performance management, quality improvement and strategic planning.
- Track and monitor improvement projects for the Board, upon request.
- Assist the Board in building a performance management dashboard, upon request.

Innovation & Technology

The Department provides Innovation and technology planning, management, and support services to the Board.

The Department will assist in assessing and recommending technologies or services that meet State Enterprise and Department standards. This includes information technology consulting services, project management, technical assistance and procurement services. The Board agrees to purchase standard technologies that can be supported by the Department.

The Department will assist with information technology activities related to applications and data, such as: project planning, business analysis, information technology security, public records research and disclosure requests, World Wide Web, data administration, and Geographic Information Systems (GIS).

The Department will provide IT business project management services including project management, project consulting and technical assistance.

The Department will provide laptop and handheld services such as standard hardware and software installation, email support, approved handheld device support, file storage space, voice communications, and video conferencing applications.

People Services / Human Resources

RCW 43.20.030 allows the Board to employ an executive director and confidential secretary, who serve at the Board's pleasure. The Department assigns some Department employees to serve as full-time or part-time support to the Board. In this capacity, these employees report to the Board's Executive Director for work assignments and directions, leave usage, annual reviews and all general daily activities. The Secretary (or their designee) delegates authority for the hiring and termination of Department employees serving as full-time or part-time staff to the Executive Director, and those other Human Resources (HR) functions that require Appointment Authority delegation. The Board's Executive Director will notify the Chief of Staff on actions related to recruitment and discipline prior to implementation. This includes the use of interns and volunteers as applicable.

The Department will provide support and consultation on human resources activities in accordance with all applicable laws, rules, Department policies and procedures, and the collective bargaining agreement by and between the State of Washington and the Washington Federation of State Employees. The Office of Human Resources will designate a point of contact for the Board for HR activities which include but are not limited to:

- Classification
- Compensation
- Labor Relations
- Corrective/Disciplinary Actions
- Reduction in Force

- Performance Development Plans
- Recruitment
- Applicable RCW and WAC interpretation
- Application of collective bargaining language
- Training and Development
- Worker's Compensation claims

The Department's Office of Human Resources will also partner with the Executive Director to ensure that Department employees that work with the Board are aware of human resource policies, related expectations for employees and how to raise questions and address issues that arise. The Executive Director will use the Department's established human resource processes, procedures, and systems. Concerns regarding HR activities will be raised to the Chief or Deputy Chief of People Services for discussion and/or action.

In order to ensure on-going communications, the Executive Director and the HR point of contact for the Board will meet regularly. When the Office of People Services becomes aware of any significant workforce issues that might have an impact on the staff of the Board (such as a reduction in force action), the Office of People Services will communicate with the Executive Director as early and often as possible. The Office of People Services will seek the Executive Director's input into changes impacting Board staff and will consider that input before any changes are made.

Rule Making

The Board of Health has broad rulemaking authority. Some of these rules are implemented by the Department of Health, or local health jurisdictions with Department assistance or oversight. Programs across the Department implement rules adopted under the Board's regulatory authority. The Board and Department agree to work together in developing rules that impact one another, and processes to adopt such rules. Rulemaking may proceed under leadership of Board staff or Department staff depending on available resources, and priorities of either party.

In many cases, Department program staff will take on the management of the rule development process, formulating proposals as recommendations to the Board. Alternatively, the Board may direct its staff to manage and lead a rule development process. Determining who will lead rule development will be based upon mutual agreement between the Executive Director and the Department's liaison to the Board, in consultation with the affected programs. Regardless of whether Board staff or Department staff leads the rule development, the Department's processes, forms and memos will be used during rulemaking for consistency. In addition, the Department will be responsible for:

- Filing all forms with the Code Reviser
- Maintaining the official rulemaking file
- Maintaining information in the Department's system for rules management.

The Board may also choose to delegate its rule making authority to the Department under RCW 43.20.050 and Board policy.

Communications

The Department and Board will work together on internal and external communication when appropriate. The Executive Director will have access to the Office of Public Affairs and Equity (OPAE) for consultation and assistance and will be consulted for recommendations on proposals to change processes. The Board will have access to OPAE services such as livestreaming, video production, graphic design, and assistance in managing public mis/dis information.

When the Board initiates a public announcement or news release, the Board's staff will draft the announcement. If the announcement or news release pertains to a department program or activities such as those implemented under a Board's rule, Board staff will solicit input from Department staff. The Board will distribute the announcement or news release to the media upon the Executive Director's approval. The Department will share routinely updated media distribution lists with the Board's Communications Manager.

When the Department is preparing to issue an announcement or news release related to a program implemented under the Board's rules, Department staff will provide the Board's Communications Manager and Executive Director an opportunity to review and comment.

Board and Department communication staff will notify one another of any media interviews related to programs implemented under the Board's rules, on issues of mutual interest, or issues or work that relate to the Board's authority. Board and Department communications staff will share Governor's alerts with one another. Board and Department communication staff will meet periodically, and the Board's Communication Manager may participate in the Department's media relations work groups.

Environmental Justice Assessments

The Department will provide support and consultation on all rule making requiring an Environmental justice assessment (EJ Assessment). The Board and the division of Environmental Public Health will coordinate the timing, development and review of necessary EJ assessments.

Foundational Public Health

As noted in RCW 43.70.512, the Board plays a key leadership role and partner to the DOH in the Governmental Public Health System. The Department shall, as requested by the Executive Director, assist in the tracking and reporting of FPHS funds allocated to the Board.

VI. Review and Effective Date

Review

The Executive Director, in consultation with the Board Chair will review this agreement with the Chief of Staff by the end of each biennium. The agreement may be revised when necessary and upon mutual written agreement of the Secretary and the Board Chair.

Effective Date

This agreement takes effect on the date of execution and shall remain in full force and effect until modified by mutual agreement of both parties.

Dated this 16th day of September 2024

Secretary, Department of Health

Patty Hayes
Chair, Board of Health

STATE OF WASHINGTON
WASHINGTON STATE BOARD OF HEALTH
PO Box 47990 • Olympia, Washington 98504-7990

August 20, 2024

Dr. Sihoun Hahn, M.D, Ph.D.
Key Proteo
720 Broadway
Seattle, WA, 98122

Sent Via Email

Dear Dr. Hahn:

Thank you for the rulemaking petition you submitted to the State Board of Health (Board) on July 26, 2024, requesting to amend Chapter 246-650 WAC to add Wilson's Disease as a condition for newborn screening.

The Board met on August 7, 2024, and after reviewing and discussing your petition, voted to deny your request at this time. The Board concluded that there was not enough information to accept the petition to begin rulemaking and instead instructed staff to follow the Board's process for evaluating candidate conditions.

The Board directed staff to work with the Department of Health to convene a technical advisory committee (TAC) to evaluate Wilson's Disease using the Board's process and criteria to evaluate conditions for inclusion in WAC 246-650-020. Our staff are currently planning TACs for a queue of conditions, we anticipate the TAC will review Wilson's Disease in Spring 2025. After the TAC completes its review of Wilson's Disease using the Board's process for evaluating candidate conditions, staff will present its findings to the Board, likely Spring or Summer 2025. The Board will then revisit whether to add Wilson's Disease to the state's newborn screening list at that time. If the Board decides to add Wilson's Disease to the state's newborn screening list, the Department of Health must ensure funding is approved by the legislature before screening for Wilson's Disease is implemented.

Under RCW 34.05.330, a petitioner may appeal an agency's decision to deny a petition to repeal or amend a rule. An appeal must be made to the Governor within 30 days of denial.

If you require further assistance, please don't hesitate to contact Kelly Kramer, Health Policy Advisor in our office, at (564) 233-5340 or at kelly.kramer@sboh.wa.gov.

Sincerely,

Kelly Oshiro, Vice Chair

STATE OF WASHINGTON
WASHINGTON STATE BOARD OF HEALTH
PO Box 47990 • Olympia, Washington 98504-7990

September 3, 2024

Alyssa Royse
5315 55th Ave. South
Seattle, WA 98118

Sent Via Email

Dear Alyssa Royse:

This letter provides formal notice that the Washington State Board of Health (Board) denied your petition for rule making, submitted on June 16, 2024, at its regular business meeting on August 7, 2024, for the reasons described below.

The petition asked the Board to revise WAC 246-272A-0240, Holding Tank Sewage Systems, to allow for external or internal storage of septic waste in approved containers with a valid pumping contract.

Prior to the meeting, Board members were provided with all materials that were submitted relating to the petition. Board staff also provided background information about the scope and intent of the existing rule and current recommendations from the Department of Health at the Board meeting.

WAC 246-272A-0420 allows local health officers to waive the requirements of the rule and allow holding tanks for the specific use requested if it meets minimum performance standards. Board members discussed these standards and stated that they support the discretion granted to local health officers by the rule, as it allows them to uniquely assess each situation to ensure the use of the tank is appropriate. Members also noted the varying geographic circumstances that could affect whether to allow these systems as well as the varying use of the waivers by counties that allow these systems, including Jefferson County and Mason County, mentioned in the petition.

RCW 34.05.330(3) allows a person to appeal a petition's denial to the Governor within 30 days of the denial.

Sincerely,

Kelly Oshiro, J.D.
Vice Chair, Washington State Board of Health

Washington State Department of Health Update

Tao Sheng Kwan-Gett, MD, MPH

CHIEF SCIENCE OFFICER, WA

Washington State Board of Health
10/08/24 | Spokane, WA

Washington State Department of HEALTH

@WaDeptHealth
@WaHealthSec
@Ushahmd

Be Well WA

WASHINGTON STATE DEPARTMENT OF HEALTH

TRANSFORMATIONAL PLAN

A VISION FOR HEALTH IN WASHINGTON STATE

OUR PRIORITIES AND VISION FOR TRANSFORMATIONAL HEALTH

I. HEALTH AND WELLNESS
All Washingtonians have the opportunity to attain their full potential of physical, mental, and social health and well-being.

II. HEALTH SYSTEMS AND WORKFORCE TRANSFORMATION
All Washingtonians are well served by a health ecosystem that is robust and responsive, while promoting transparency, equity, and trust.

III. ENVIRONMENTAL HEALTH
All Washingtonians will thrive in a broad range of healthy environments — natural, built, and social.

IV. EMERGENCY RESPONSE AND RESILIENCE
All Washington communities have the information and resources they need to build resilience in the face of myriad public health threats and are well-positioned to prepare for, respond to, and recover from emergencies and natural disasters.

V. GLOBAL AND ONE HEALTH
All Washingtonians live in ever-connected environments that recognize and leverage the intersection of both global and domestic health as well as the connections of humans, animals, and the environment.

TRANSFORMATIONS IN ACTION

INNOVATION AND TECHNOLOGY | COMMUNITY CENTERED | VISIBILITY AND VALUE | EQUITY DRIVEN | COLLABORATIVE ENGAGEMENT

CORNERSTONE VALUES: EQUITY • INNOVATION • ENGAGEMENT
VISION: EQUITY AND OPTIMAL HEALTH FOR ALL


BE
WELL WA
HELPING EVERYONE, EVERYWHERE
in Washington Attain better health and well-being
Be
well
WA

BE WELL WA PILLARS OF HEALTH:

Movement

Even with physical limitations, we can see health gains by incorporating gentle movement into daily living.

Nourishment

Choosing foods that nourish the body and mind and having good sleep habits helps us stay well.

Emotional Well-Being

Emotional well-being can affect our overall health and ability to try to improve situations.

Social Connection

Social connections can occur with neighbors, family, friends, coworkers, and other people in our community.

Powered by PARTNERSHIPS

Be Well WA

FIND YOUR APPLE...

For more information, please visit:

BeWellWA.org or email: BeWellWA@doh.wa.gov

Be Well WA Across Washington

THE SPOKESMAN-REVIEW

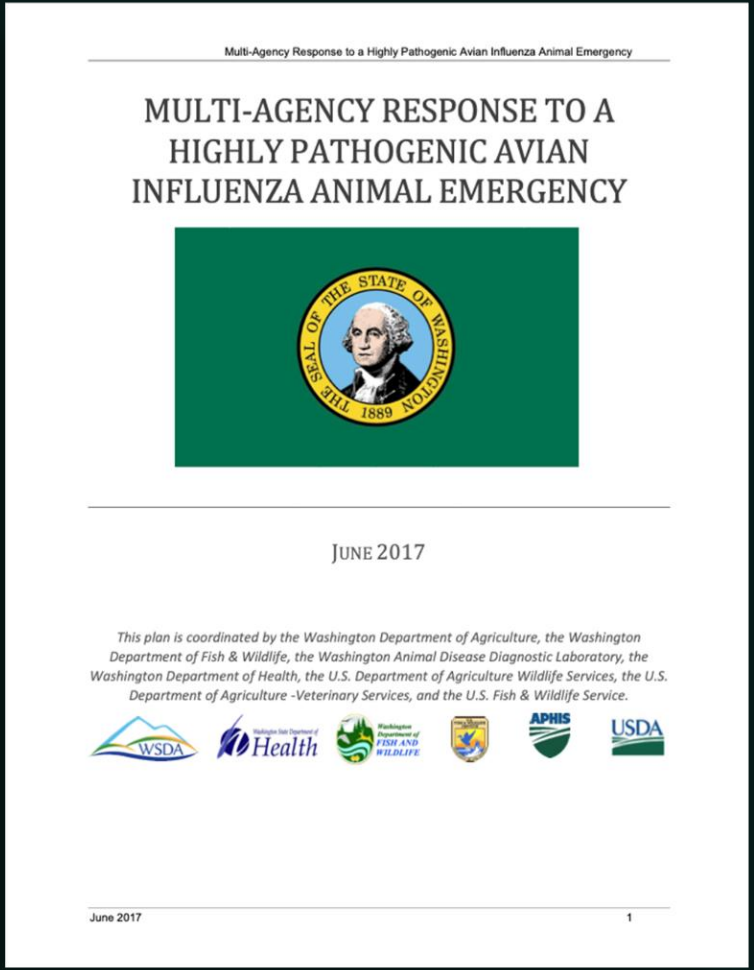
Spokane, Washington Est. May 19, 1883

Washington Idaho Business Education Health Photos Further Review

Be Well WA initiative encourages small steps to improved health

HPAI, Mpox, Respiratory Disease

HPAI Public Health's Role in Response in WA


Multi-Agency Response to a Highly Pathogenic Avian Influenza Animal Emergency

MULTI-AGENCY RESPONSE TO A HIGHLY PATHOGENIC AVIAN INFLUENZA ANIMAL EMERGENCY

JUNE 2017

This plan is coordinated by the Washington Department of Agriculture, the Washington Department of Fish & Wildlife, the Washington Animal Disease Diagnostic Laboratory, the Washington Department of Health, the U.S. Department of Agriculture Wildlife Services, the U.S. Department of Agriculture -Veterinary Services, and the U.S. Fish & Wildlife Service.

June 2017 1

- Washington has an existing multi-agency response plan for HPAI in animals

- Influenza A(H5N1) is primarily an animal health emergency

- Primary public health responsibilities:
    - Symptom monitoring of potentially exposed
    - Testing and treatment if symptoms develop
    - Communications and health education messaging

HPAI Activity in WA

- No human cases of H5N1 have been reported in WA (more than 20 tested)

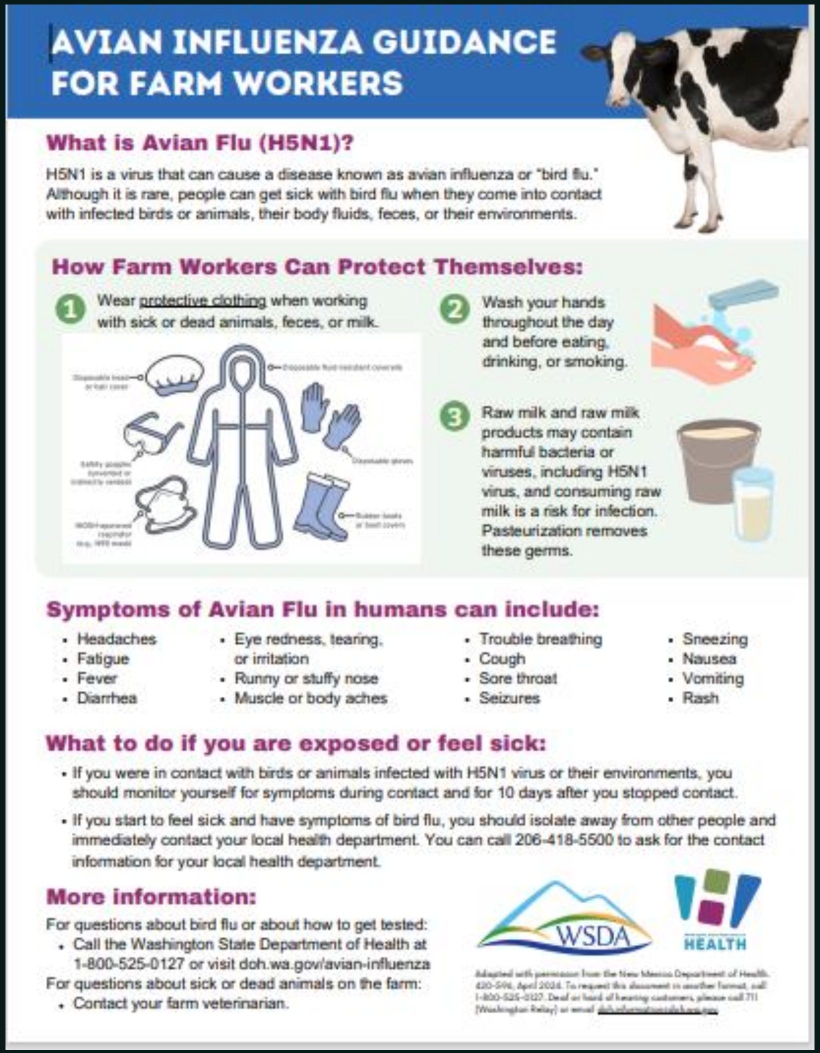
- No detections of H5N1 have been reported in dairy cattle in WA

- No detections of H5N1 reported in poultry in WA since December 2023

- No detections of H5N1 reported in wildlife in WA since March 2024

Washington has approximately 480 dairies with an average of about 550 cows per dairy.

WA-DOH Preparedness Activities


AVIAN INFLUENZA GUIDANCE FOR FARM WORKERS

What is Avian Flu (H5N1)?

H5N1 is a virus that can cause a disease known as avian influenza or "bird flu." Although it is rare, people can get sick with bird flu when they come into contact with infected birds or animals, their body fluids, feces, or their environments.

How Farm Workers Can Protect Themselves:

1. Wear protective clothing when working with sick or dead animals, feces, or milk.
2. Wash your hands throughout the day and before eating, drinking, or smoking.
3. Raw milk and raw milk products may contain harmful bacteria or viruses, including H5N1 virus, and consuming raw milk is a risk for infection. Pasteurization removes these germs.

Symptoms of Avian Flu in humans can include:

- Headaches
- Fatigue
- Fever
- Diarrhea
- Eye redness, tearing, or irritation
- Runny or stuffy nose
- Muscle or body aches
- Trouble breathing
- Cough
- Sore throat
- Seizures
- Sneezing
- Nausea
- Vomiting
- Rash

What to do if you are exposed or feel sick:

- If you were in contact with birds or animals infected with H5N1 virus or their environments, you should monitor yourself for symptoms during contact and for 10 days after you stopped contact.
- If you start to feel sick and have symptoms of bird flu, you should isolate away from other people and immediately contact your local health department. You can call 206-418-5500 to ask for the contact information for your local health department.

More information:

For questions about bird flu or about how to get tested:
- Call the Washington State Department of Health at 1-800-525-0127 or visit doh.wa.gov/avian-influenza

For questions about sick or dead animals on the farm:
- Contact your farm veterinarian.

WSDA

HEALTH

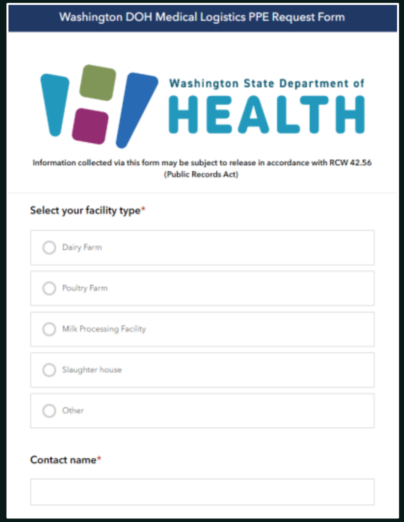
- Bi-weekly meetings with One Health partners (WSDA, WDFW).
- Data sharing with WSDA and WDFW on animal testing and public health investigations.
- Multiple presentations to public health, healthcare, veterinarians, tribes, elected officials (including congressional delegation), and agriculture, often with WSDA and other partners.
- Resources and communications: alerts, LHJ resources, co-branded farm resources, website updates, and draft statements.

WA DOH Preparedness Activities

- Multi-Agency HPAI Readiness Group
  - Coordinates efforts for HPAI by bringing together local, tribal, and state partners
  - Ensures that communication flows smoothly
  - Monitors for animal and human cases
  - Coordinates with Medical Logistics Center to facilitate PPE distribution

- Coordinated genomic epi group analyzing and sharing molecular sequencing data (includes WA-DOH, Washington State University's WA Animal Disease Diagnostic Lab (WADDL), WDFW, British Columbia Centers for Disease Control, and others)

- Preparing for wastewater influenza subtyping (already doing wastewater surveillance for influenza A)


Washington DOH Medical Logistics PPE Request Form

Washington State Department of HEALTH

Information collected via this form may be subject to release in accordance with RCW 42.56 (Public Records Act)

Select your facility type*

- Dairy Farm
- Poultry Farm
- Milk Processing Facility
- Slaughter house
- Other

Contact name*

Online PPE Request Form

Washington State Department of HEALTH

@WaDeptHealth
@WaHealthSec
@Ushahmd

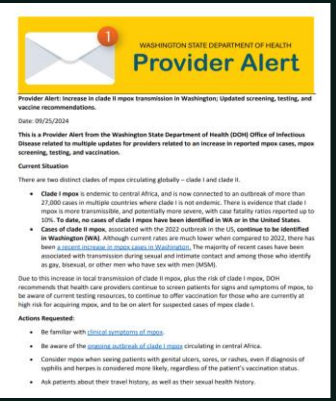
HPAI Policy Decisions to Support Response

Continued monitoring through multi-modal biosurveillance of human and animal populations.

- USDA enacted a Federal Movement Order for dairy cattle and financial assistance programs to encourage testing and PPE use
- WA State Labor & Industries does have requirements for employers to provide PPE to their employees and train them on the proper use of PPE in the case of avian influenza detections
- Other states have enacted policies, through their Depts of Agriculture:
  - **Mandatory bulk milk tank testing or double-blind milk tank testing**
  - **Mandatory testing before agricultural fair showing of lactating dairy cows**

Mpox Clade I

- Outbreak in Democratic Republic of the Congo
- Spread mainly through skin-to-skin contact, including sexual contact
- Higher fatality rate than Clade II (cause of 2022 outbreak)
- No reported case of Clade I in United States, though recent increase in Clade II cases in WA
- CDC recommends vaccination with two doses of JYNNEOS
- Health alerts issued in August and September


WASHINGTON STATE DEPARTMENT OF HEALTH
Provider Alert

Provider Alert: Increase in clade II mpox transmission in Washington; Updated screening, testing, and vaccine recommendations.

Date: 09/25/2024

This is a Provider Alert from the Washington State Department of Health (DOH) Office of Infectious Disease related to multiple updates for providers related to an increase in reported mpox cases, mpox screening, testing, and vaccination.

Current Situation

There are two distinct clades of mpox circulating globally – clade I and clade II.

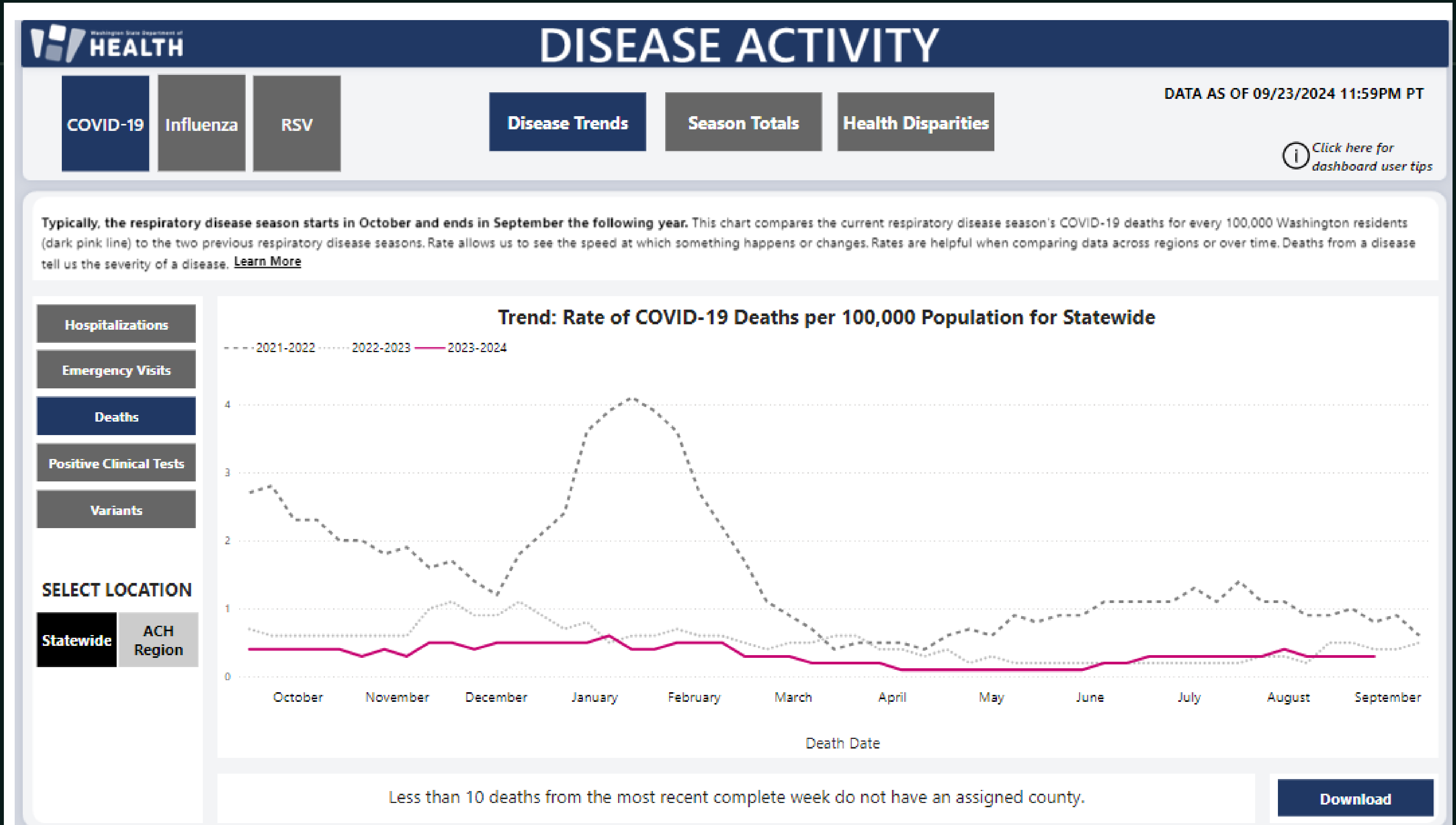
- **Clade I mpox** is endemic to central Africa, and is now connected to an outbreak of more than 27,000 cases in multiple countries where clade I is not endemic. There is evidence that clade I mpox is more transmissible, and potentially more severe, with case fatality ratios reported up to 10%. **To date, no cases of clade I mpox have been identified in WA or in the United States.**
- **Cases of clade II mpox**, associated with the 2022 outbreak in the US, **continue to be identified in Washington (WA)**. Although current rates are much lower when compared to 2022, there has been a recent increase in mpox cases in Washington. The majority of recent cases have been associated with transmission during sexual and intimate contact and among those who identify as gay, bisexual, or other men who have sex with men (MSM).

Due to this increase in local transmission of clade II mpox, plus the risk of clade I mpox, DOH recommends that health care providers continue to screen patients for signs and symptoms of mpox, to be aware of current testing resources, to continue to offer vaccination for those who are currently at high risk for acquiring mpox, and to be on alert for suspected cases of mpox clade I.

Actions Requested:

- Be familiar with clinical symptoms of mpox.
- Be aware of the ongoing outbreak of clade I mpox circulating in central Africa.
- Consider mpox when seeing patients with genital ulcers, sores, or rashes, even if diagnosis of syphilis and herpes is considered more likely, regardless of the patient's vaccination status.
- Ask patients about their travel history, as well as their sexual health history.

Respiratory Illness Data Dashboard



Respiratory Disease Testing and Prevention

- Free COVID-19 tests are now available through the U.S. Department of Health and Human Services while supplies last at COVIDTests.gov
- RSV Vaccine keeps older people out of the hospital
- New COVID and flu vaccines available that decrease risk of hospitalization and death

IN IT TOGETHER!

Umair A. Shah, MD, MPH
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Secretary@doh.wa.gov

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@WaHealthSec
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